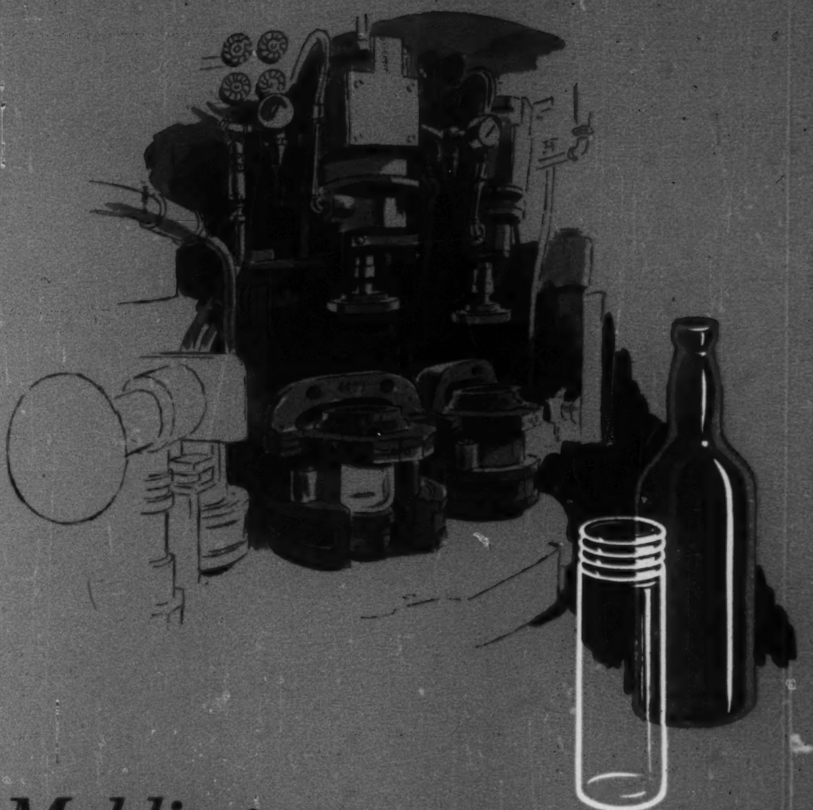
AUTOMATION

JANUARY 1960



Molding Glass Containers

THE MAGAZINE OF AUTOMATIC MANUFACTURING OPERATIONS

- **Establishing an Automated Plant**
- **Mixing Bread Dough Continuously**
- **Applying Telephone Relays**
- **High Speed Capsule Packaging**

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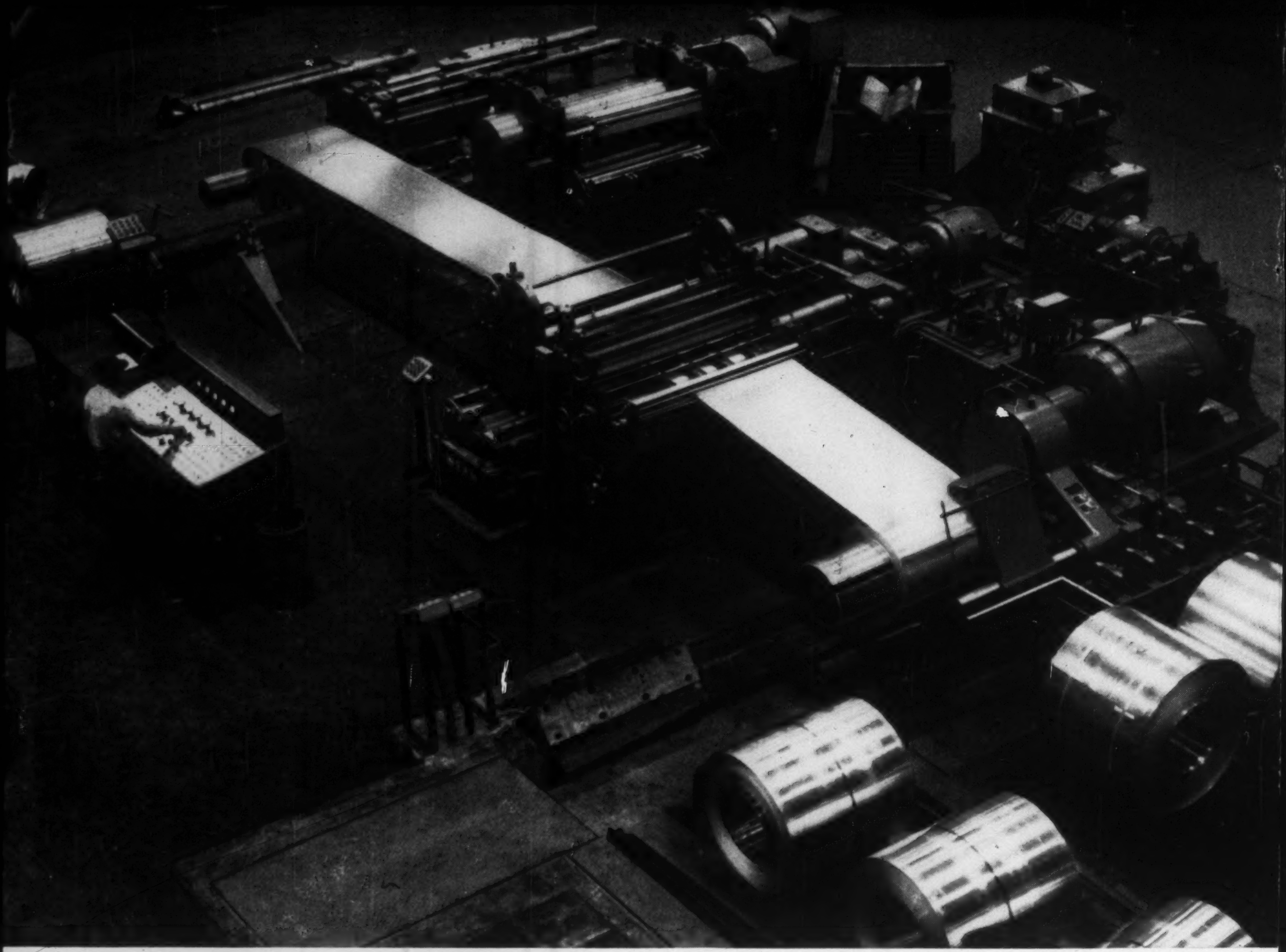
A PENTON PUBLICATION



Anaconda Aluminum slits, side-trims, embosses sheet on one versatile Wean coil processing line

Unique versatility is the outstanding feature of this Wean light-gauge slitting and embossing line at Anaconda Aluminum Co.'s new fabricating plant at Terre Haute, Indiana. On this one compact line Anaconda Aluminum has the options of slitting and side-trimming, embossing, or side-trimming and embossing aluminum in widths to 60". As shown in the photo, the embossing stand is withdrawn when not in use.

One of the special design features of this Wean coil processing line is a completely variable voltage system coupling all drive units. In combination with an electrical drag generator on the uncoiler, this control system gives uniform strip tension throughout all pre-set speed ranges. Line speeds vary up to 400 fpm on embossing and up to 1,000 fpm on slitting: gauges handled range from .008-.075".

Anaconda Aluminum Co. has two other Wean coil processing lines in this same plant: heavy-gauge slitting and shearing, and a "Flying Press" blanking line.

Coil processing of non-ferrous and ferrous metals is Wean's specialty. No matter what operation you need to perform on coiled metals, Wean's experience can help you do it faster, better and more economically. We'd like to have a chance to prove that statement on your next coil processing application.

WEAN EQUIPMENT CORPORATION
CLEVELAND 17, OHIO
Detroit • Chicago • Newark

WEAN

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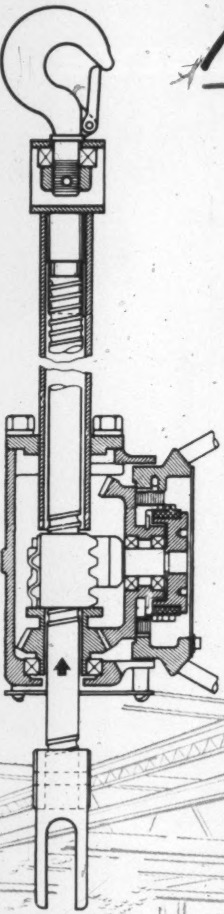
NEW Whiting Ladle Handler Lifts 100 lbs for Every Pound of Effort!

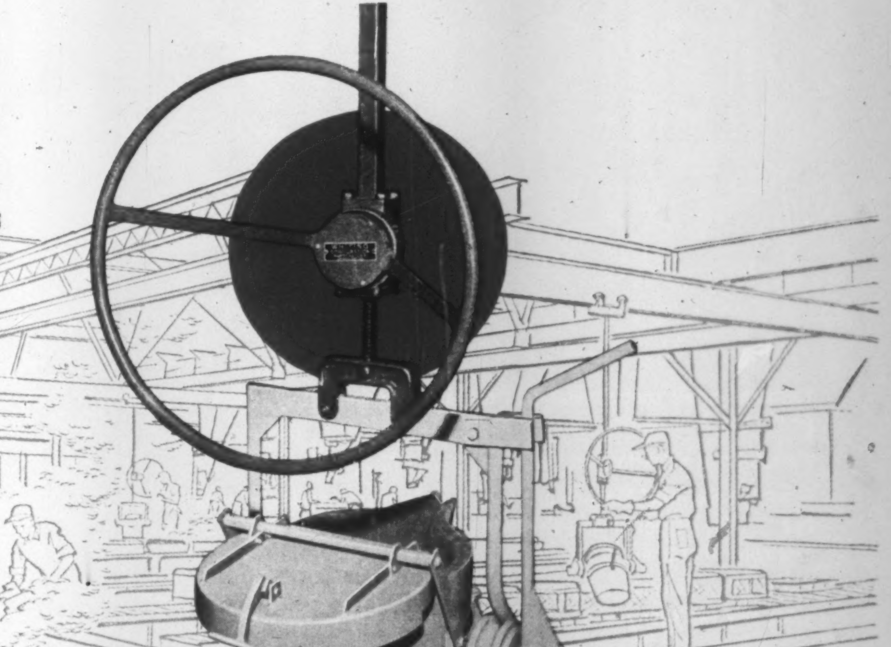


. . . made possible by the Saginaw b/b Screw!

The Whiting Corporation, heavy foundry equipment manufacturers, designed a ladle handler that lets the operator manually raise and lower a gross weight of over 2250 pounds with maximum ease and control. The Saginaw Ball Bearing Screw got the actuation job!

A turn of the handwheel on the new 'H-E' Ladle Handler transmits torque to the Saginaw Screw which converts *rotary* motion into *linear* motion with over *90% efficiency*. This, with a unique clutch-brake spring, helps the operator LIFT 100 POUNDS FOR EVERY POUND OF EFFORT, and maintain control at all times! The Saginaw Screw also provided savings in maintenance, wear, parts and weight.

The Saginaw Screw may be able to improve your product's performance and increase its sales acceptance. Write or telephone Saginaw Steering Gear Division, General Motors Corporation, Saginaw, Michigan—*world's largest producers of b/b screws and splines.*



A Size and Type for Every Need...

Have been built as small as 3/16 in. B.C.D. and 1½ in. long, as large as 6 in. B.C.D. and 40 ft. long. Larger sizes can be built to your order.

Saginaw

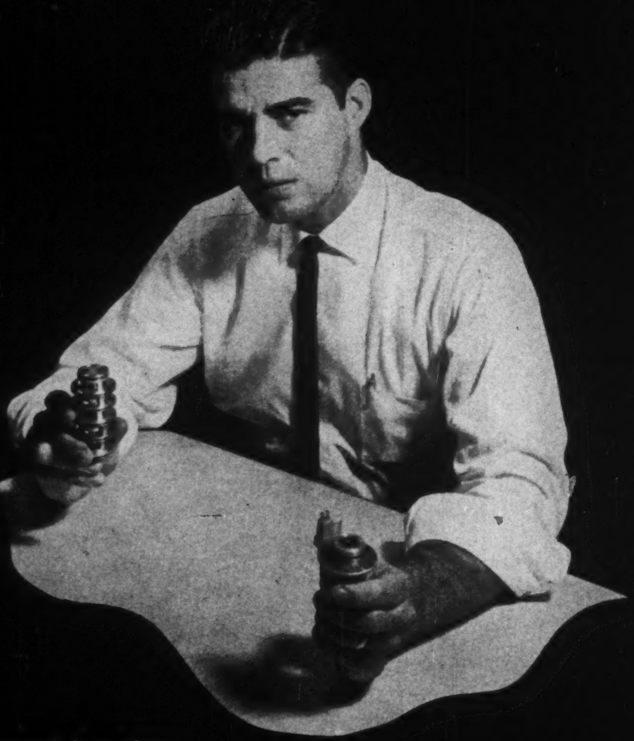
ball/bearing Screw

WORLD'S MOST EFFICIENT ACTUATION DEVICE

*After years....*if you do have to "repack"

JUST REPLACE 2 SELF-CONTAINED UNITS

IF IT'S A HUNT PDQ AIR VALVE



You want an air control valve that **one man can completely repack in a minute** on the bench or on the line.

We have that valve for you.

To repack the HUNT PDQ you just slide two simple self-contained units into place. One . . . the poppet spindle-sleeve assembly. Two . . . the plug-in solenoid pilot assembly. That's all!

You want a minimum inventory of spare parts. With the HUNT PDQ valve you stock **only two spare units** . . . not several dozen parts.

One man . . . any man . . . can completely repack the PDQ (including the solenoid pilot section) in less time than it takes you to read this ad. And your line is back in operation again.

This is the valve you want and need. Write today for the full story on the PDQ.

A. V. Ney

A. V. Ney, Sales Manager

HUNT VALVE COMPANY · SALEM, OHIO, U. S. A.

- ☑ Accessibility
- ☑ Simplicity
- ☐ Speed and Capacity
- ☐ Price and Quality

The Hunt PDQ valve tops them all in every class.

Next month . . .
the SPEED and CAPACITY story.

HUNT **Quick-As-Wink** AIR & HYDRAULIC CONTROL VALVES

JANUARY 1960
Vol. 7 — No. 1

AUTOMATION®

A PENTON PUBLICATION

The Magazine of
Automatic Manufacturing Operations

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Penton Building, Cleveland 13, Ohio

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automation outlook

TRAINED WORKERS NEEDED

". . . automation will never replace postal workers. In fact, we will need more and more of them in the future. But they will need more training to handle the complicated machines. Their pay will be higher and their work easier. . ."—*E. O. Sessions, Deputy Postmaster General.*

INSPECTION BOTTLENECK

". . . automation offers quality control people an opportunity to extend their effort into the field of automated inspection and automated control of quality. So far, most of the people designing automated processes have been production people. The result is a fast, automated process which has high volume output, and a bottlenecked inspection. Automation demands built-in assurance of quality. Should the quality control man leave this problem to be settled by management on a higher level? Or should the quality control people learn how to automate their own processes? . . ."—*George A. Peck, vice president & general manager, Electronics Div., Stromberg-Carlson Div., General Dynamics Corp.*

BETTER MANAGEMENT REPORTS

". . . one of the most significant improvements which automatic data processing can accomplish in bank operations is in the preparation of management reports containing more meaningful, accurate, and current information. . ." —*Neal J. Dean, technical director, electronic data processing, Booz-Allen & Hamilton.*

UPGRADED LABOR

". . . the beneficial result of technology, whether in farming or industry, is the upgrading of labor, both in pay and in the type of work performed. There may be fewer opportunities for common labor today, but the skilled and semiskilled artisans have opportunities which are more rewarding, and the nature of their work is more attractive. . ."—*Samuel Lenher, vice president & director, E. I. du Pont de Nemours & Co.*

MORE SKILLS NEEDED

". . . automation may not only present a problem of new skills in itself, but also a quantitative increase in certain existing skills, such as those of machine tool manufacture and maintenance technicians for specialized equipment. . ." —*Malcolm P. Ferguson, president, Bendix Aviation Corp.*

MANAGEMENT AND MANUFACTURING RESEARCH

". . . it appears that management has not given sufficient study to processes and manufacturing research . . . It may be advisable to encourage top management to give more personal attention to this area, evaluating carefully the possible needs for considering what may be many worthwhile advantages of the more expensive possibilities rather than settling for a 'price package.' Only top management can evaluate whether an outlay of funds for an automated line utilizing the best proved processing techniques is the greatest value for the company over a period of time . . ."—*R. F. Merwin, president, Eriez Manufacturing Co.*

AUTOMATION

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BPA NBP

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...Fluid Power news

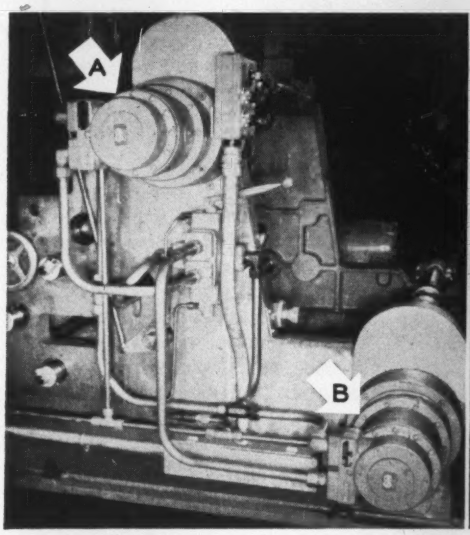
REPORT
No. 12,300
HIGH
PERFORMANCE
WINDER
DRIVES

From Oilgear Application-Engineering Files

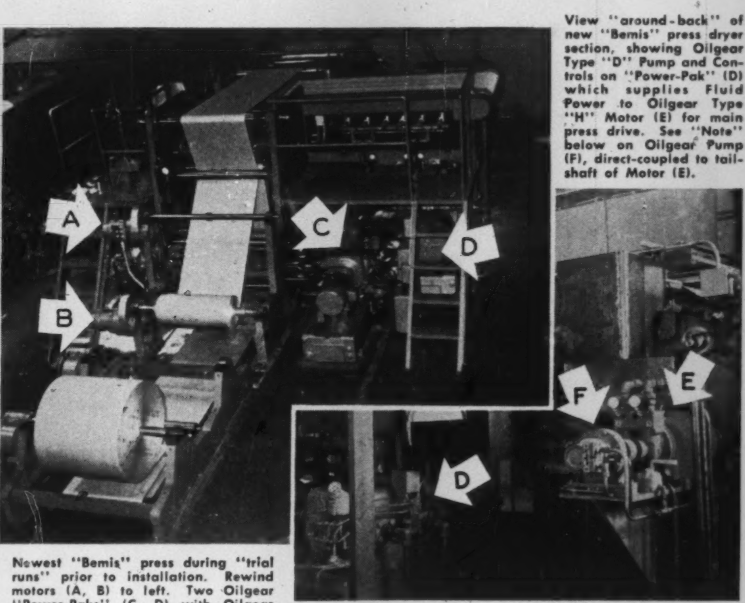
HOW OILGEAR PROGRESSIVE ENGINEERING PACES IMPROVEMENTS ON "BEMIS" MACHINES

CUSTOMER: *Bemis Bro. Bag Company, St. Louis, Missouri*

DATA: To efficiently produce the wide scope of paper, cloth, and polyethylene "Flexible Packaging" for which they are famous, "Bemis" designs and builds their own production machinery. Basically, "Bemis" machines are roll-fed, multi-color printing presses capable of very close register . . . operating from inching speeds of 15 fpm to running speeds of 400 to 1000 fpm. Press runs range from 1000 to 1,000,000 bags. Being roll-fed presses, winder drives and controls were a major problem, as ratios of 5:1 up to 10:1 from core to finished roll diameter are not uncommon. Paper widths vary from 10" to 56", with roll weights from 1000 to 2000 lb. "Bemis" specified that their winder drives must be compact; easy for shop, maintenance, and operator personnel to adjust, maintain, and understand. All electrical controls must be simple, with standard components preferred. Each machine to have one main control panel, and three or four remote, push-button panels — with some constant indication of load and tension as a desirable feature. Long, trouble and maintenance-free life was also of prime importance along with ease in installation.



Close-up of face-mounted, Oilgear Type "H" Fluid Power Motors (A, B), geared to rewind spindles of newest "Bemis" machine, shown center. Oilgear Type "D" Pump on "Power-Pak" (C) — center photo — supplies Fluid Power for rewind drive.



View "around-back" of new "Bemis" press dryer section, showing Oilgear Type "D" Pump and Controls on "Power-Pak" (D) which supplies Fluid Power to Oilgear Type "H" Motor (E) for main press drive. See "Note" below on Oilgear Pump (F), direct-coupled to tail-shaft of Motor (E).

Newest "Bemis" press during "trial runs" prior to installation. Rewind motors (A, B) to left. Two Oilgear "Power-Paks" (C, D) with Oilgear Type "D" Pumps and Controls can be seen "tucked away" under the dryer section.

SOLUTION: Through a program of constant improvement and engineering teamwork, Oilgear *Fluid Power* Drive and Control Systems have so successfully paced requirements for more efficient production equipment that "Bemis" plants in 16 cities now have 48 machines equipped with Oilgear winder drives. Dancer roll controls are used on 39 . . . 9 more recent installations have "*HYTAC SYSTEM" drives. Two newest machines (one shown above) have Oilgear Type "D" electrohydraulic servo controlled main press drives, and hydraulic servo controlled winder drives. One reason for this ever-increasing use of Oilgear "Any-Speed" drives has been clearly stated as follows: *"We put them in and forget about them . . . some have been operating for over 11 years without service or repair — many loaded to maximum capacity — others have had no oil change in five years"* . . . proof of the statement heard in all industry — *"For the lowest cost per year — it's Oilgear!"* One "Bemis" installation using a HYTAC SYSTEM winder drive handles 40 to 70-lb kraft stock 26" to 63" wide. This winder operates over a 13:1 ratio — from 3¼" diam. cores to 43½" diam. rolls — is limited only by interference on the machine. Of this HYTAC SYSTEM, "Bemis" states — *"Other types of variable speed drives could never do this . . . operating beyond our fondest hopes."*

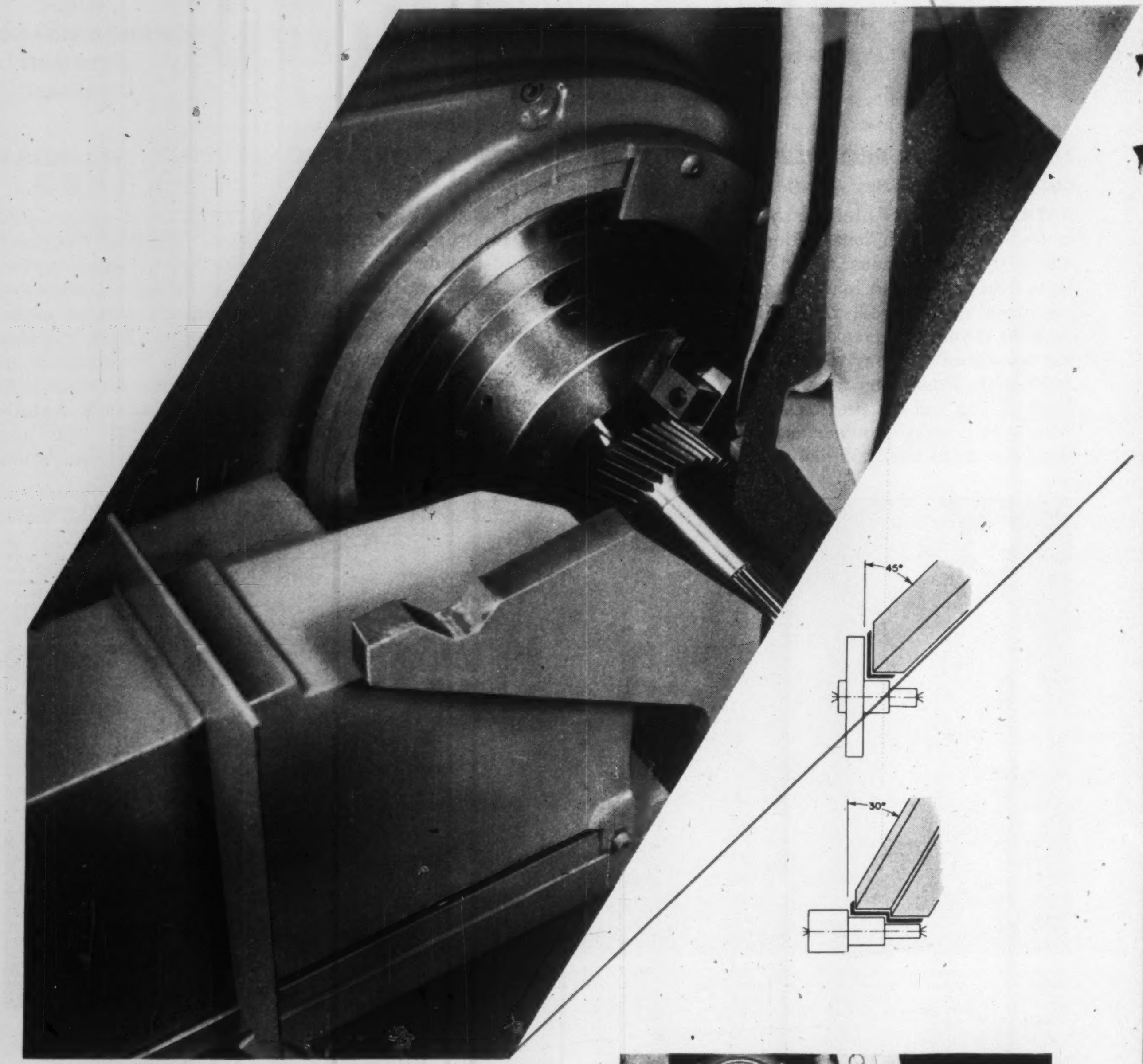
*HYTAC SYSTEMS — An Oilgear Trademark

NOTE: *An unusual installation feature is partially visible on photo above. Oilgear Type "H" Fluid Power main press drive motor (E) is also direct-coupled to Oilgear Type "H" Pump (F) which supplies Fluid Power to an Oilgear Type "H" Motor — not shown — that drives the dryer fan.*

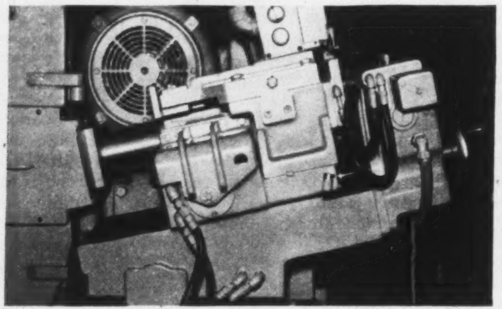
USER REPORTS — *" . . . exceptionally fine acceleration control . . . smooth creeping and inching speed up to maximum . . . exceptionally smooth running speed . . . are easier to adjust than other drives . . . require less space . . . pressure gage shows load while drive is in operation . . . maintain an adjustable tension from constant tension to constant torque."* "Bemis" — like other users — has found that Oilgear Drive and Control Systems give them constant tension, automatic tapering tension, stall tension, constant torque, automatic tapering torque, or a combination of tension and torque characteristics to meet their every production requirement.

For practical solutions to YOUR linear or rotary Controlled-Motion problem, call the factory-trained Oilgear Application-Engineer in your vicinity. Or write, stating your specific requirements, directly to . . .

THE OILGEAR COMPANY
Application-Engineered Controlled Motion Systems
1598 WEST PIERCE STREET • MILWAUKEE 4, WISCONSIN



A long diameter and the adjacent face of drive gears are precision ground on a CINCINNATI FILMATIC Angular Wheel Slide Grinding Machine equipped with automatic sizing and flagging combined.



Wheel Truing Unit, push-button operated from front of machine. Balanced hydraulic system and two-way truing assure precise duplication of cam contour in face of wheel.

BUILDERS OF PRECISION GRINDING MACHINES: CENTERTYPE • CENTERLESS • MICRO-CENTRIC

THE CINCINNATI MILLING MACHINE CO., CINCINNATI 9, OHIO

CINCINNATI FILMATIC

CINCINNATI GRINDING MACHINE DIVISION checks all the Angles...

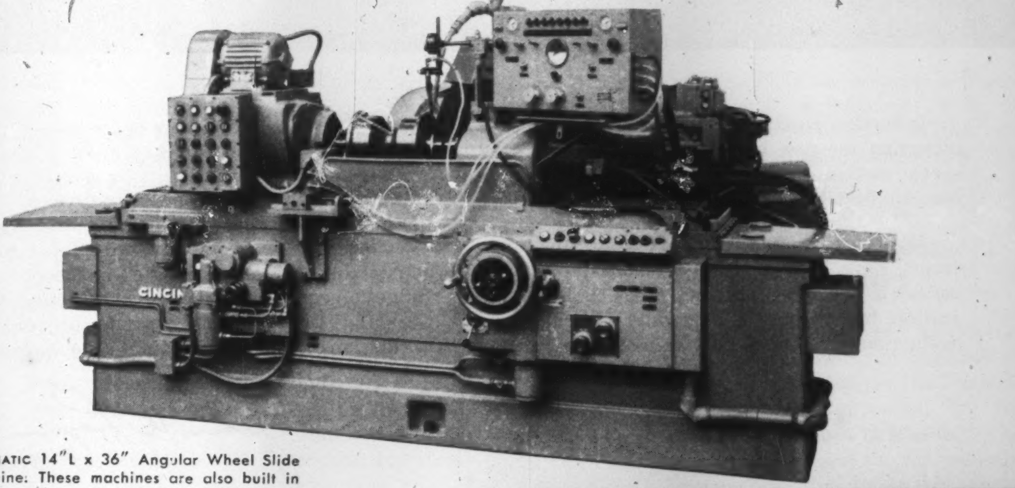
to combine diameter and shoulder grinding operations profitably

Like other methods of machining, precision grinding operations often can be combined at a substantial saving in cost. However, factors other than the mere combining of operations must be considered. Accurate wheel truing heads the list. Cincinnati Grinding Machine Division Specialists solved the problem in a unique and highly successful manner for angular wheel slide grinding.

The wheel is *automatically* trued to exact profile by merely pushing a button at front of the machine. A balanced hydraulic system, incorporating longitudinal and transverse cylinders under control of a directional integrating valve, assures sensitive, precise duplication of the cam contour in the wheel. Profile slide way is anti-friction; no twist, no stick-slip.

Combined diameter and shoulder grinding operations are analyzed from every angle by Cincinnati Grinding Specialists. These men have two wheelhead arrangements on which to base their recommendations —30° for diameters having a length considerably greater than the height of the shoulder, and 45° where height of shoulder equals or exceeds length of ground diameter.

Other feature-advantages include an automatic infeed cycle that incorporates rapid approach, coarse feed and fine feed rates for sizing and finish. For extra high production work where stock allowances are inconsistent, the Gap Eliminator cuts down the time spent in "grinding air." Automatic sizing and flagging are highly desirable quality control features. Complete details are in catalog No. G-686-1. May we send you a copy?



CINCINNATI FILMATIC 14"L x 36" Angular Wheel Slide Grinding Machine: These machines are also built in 6" and 10" swing sizes. Catalog No. G-686-1.

• ROLL • CHUCKING • CENTERLESS LAPPING

CINCINNATI®
GRINDING MACHINE DIVISION

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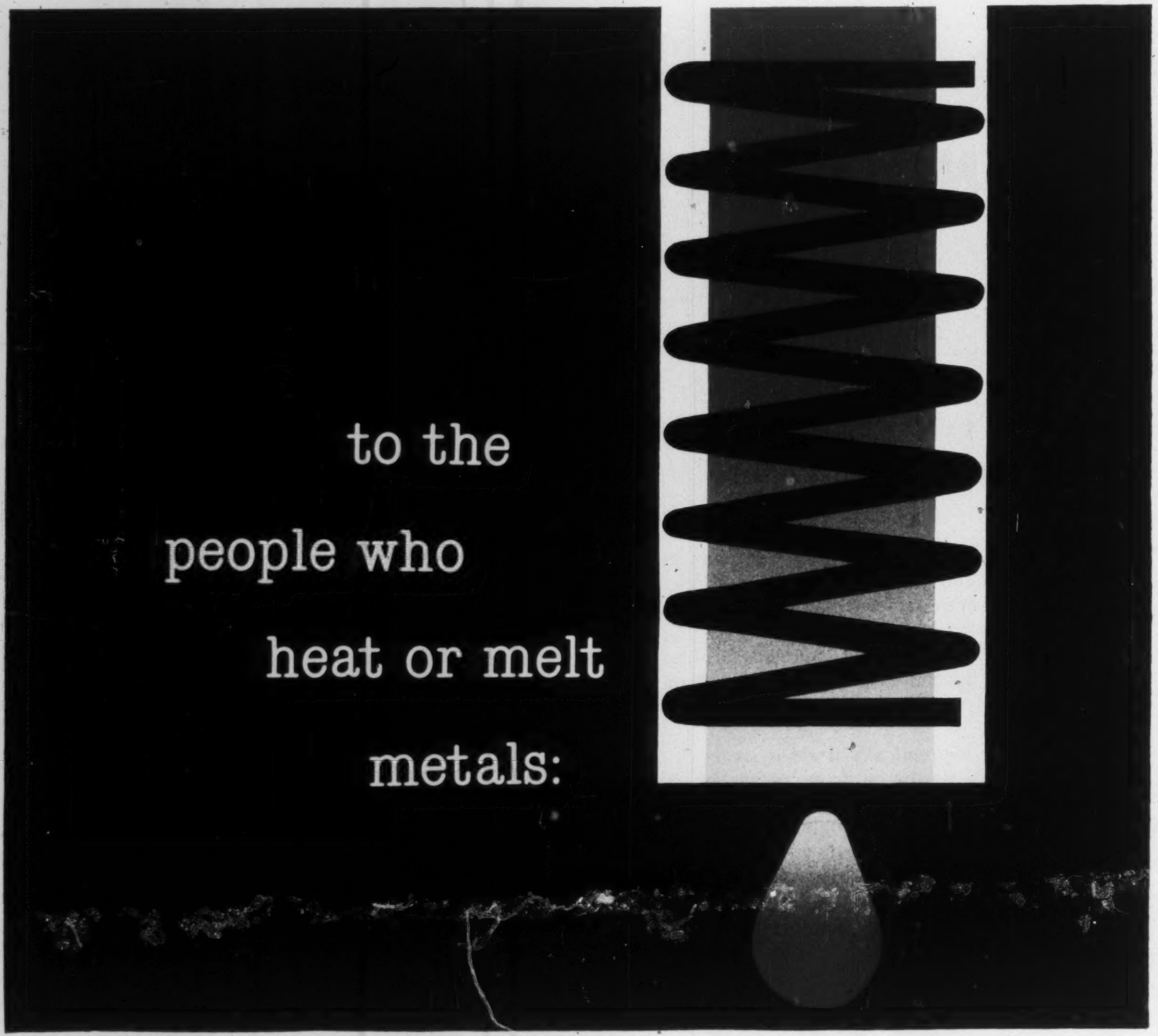

Induction Heating is used to heat all metals, including the new high-temperature alloys and exotic metals, to temperatures ranging from a few hundred degrees to several thousand degrees.

Historically, Induction Heating manufacturers have specialized and have provided a service to specific application areas. This specialization has confined the many advantages of Induction to a few specific fields. Actually, most metalworking operations can be improved by the use of Induction equipment.

By joining the pioneer companies (Ajax Electrothermic, Ajax Engineering and Magnethermic) into one company, we offer a service unavailable before. A single manufacturer of Induction equipment with the background, facilities and product line permits an unbiased evaluation of your heating or melting application.

John A Logan
President

More A M equipment in use than any other make.

Induction Heating is our ONLY Business

Ajax Magnethermic
CORPORATION

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AJAX ELECTROTHERMIC DIVISION
Trenton 5, New Jersey

MAGNETHERMIC DIVISION
Youngstown 1, Ohio

AJAX ENGINEERING DIVISION
Trenton 7, New Jersey

Circle 657 on Page 19

AUTOMATION news

Today's events and developments in the field of automation

OFFICIAL U.S. Navy photograph shows telephone inquiry center where stock status inquiries are processed for any of 575,000 items carried by Naval Supply Center at Norfolk, Va. Requests for interrogation of electronic data processing system (background) are received by six telephone operators (in booths) who fill out item identification forms from which punched tape is prepared. Tape reader then initiates search of data storage units, resulting in printout of stock status information on tabulator. Information is then given to telephone operators for immediate reply to requests.

Government Agency Acquires Data Handling System

KEEPING TRACK of the movements of 575,000 different stock items is a major undertaking at the Naval Supply Center in Norfolk, Va. In an average month the Center receives over 200,000 request documents and ships out more than 145,000 tons of supplies and equipment to U. S. Navy bases and fleets, other naval groups, and NATO allies.

To facilitate handling the masses of data involved in conducting this large volume of business, the Center has recently acquired a Burroughs Corp. electronic data processing system. Providing routine decisions automatically, the Burroughs 220 system will be used to determine the availability of items requested for shipment, create shipping invoices, and update stock and financial records. It will also prepare integrated personnel records and print special management reports to facilitate executive decisions.

An interesting feature of the system is its provision for rapid, random access to the inventory information stored in multiple-bin Datafiles. Through a "telephone inquiry unit," inquiries from a variety of sources are received by six telephone inquiry clerks. Each clerk fills out an interrogation form, entering the EDP system search keys (Federal item identification numbers) for the items being checked.

In the next step the search keys are recorded on punched tape. Then a photoreader scans the tape and transmits input signals to the data processor. When a signal is recognized by the data processor, an internal search program is initiated in its Datafile. Answers to inquiries are printed out on a tabulator, which indicates whether or not the keyed item is carried in stock. For items that are carried, stock status is automatically printed out. Items not carried in stock receive an "NC" (not carried) designation. Elapsed time between the receipt of a telephone inquiry call and transmission of stock status information to the telephone inquiry clerk is estimated to be about 73 seconds.

Use of the data processing system at the Center will result in faster service, more consistent decisions, more centralized and up-to-date information, and better utilization of personnel and equipment.

The computing system's high operational speeds will keep inventory records updated daily and provide electronic "management-by-exception." That is, routine decisions concerning requisitions will be made automatically, freeing the Center's skilled personnel for "exception situations."

Business Report Forecasts Best Year In History

BUSINESS in 1960 will be the best in history according to forecasts by the staff of *Report for the Business Executive,* a publication of the Bureau of National Affairs Inc. The forecasts are based on the assumption that the steel strike will not be resumed.

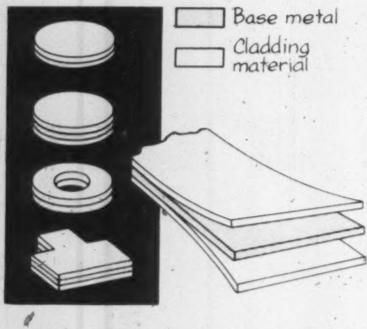
Estimates of what will happen to key business indicators in 1960 include:

- Gross National Product will average about $507 billion for the year, an increase of 6 per cent over 1959.

- Industrial production will average 5 per cent higher than in 1959, or about 157 per cent of the 1947-49 level. Highest gains will be in durables. Productivity is rising and industry will be operating at 85 per cent of capacity or better.
- Employment will rise about 3 per cent during 1960, to an average of 67 million. Unemployment will come down from the 1959 average of 3.8 million to around 3.4 million.

The *Report* staff also made several projections for specific segments of industry:

- Steel output will rise by about 35 per cent to around 125 million tons. Capacity, now estimated at 147.6 million tons, will be increased by about 3 million tons.
- Nonferrous metals sales will rise in 1960, and prices will be slightly higher. Supplies will be adequate.



STRIPS of base metals such as nickel, kovar, and molybdenum steel may be clad on one or both sides with tin-lead solder, silver, gold, and alloy materials through a new bonding process developed by Alloys Unlimited Inc. The clad strips may be stamped into discs, washers, and special shapes for use in automatic joining operations. Applications for stampings include use as heat sinks, base rings or tabs, diaphragms, and contacts for special electronic applications. Clad metal stampings may be supplied to meet the critical purity and dimensional tolerances required for semiconductor devices.

- Machine tools will duplicate a 15 per cent gain experienced in 1959. Orders from the automotive industry will be strong. Lathes, drill presses, grinders, milling machines, and boring machines will lead.
- Office machines will conform to recent trends, gaining 5 to 10 per cent in 1960. Computers and accounting machines will lead the field.
- Materials handling sales will gain 5 per cent, compared with a 12 to 15 per cent rise in 1959. Conveyor equipment and industrial trucks will sell best.
- Over-all, machinery sales will rise 12 to 15 per cent during 1960. Prices will be increased 5 to 7 per cent.
- In the chemicals industries total sales may increase by 10 per cent to $28.2 billion. Plant expansion may involve spending of $1.5 billion by the chemical companies in 1960.
- The electronics industry will increase sales by 12 per cent to attain a record $9.5 billion in 1960. Defense and civilian spending will both rise.
- Electric power consumption will rise 9 per cent, with industrial use up faster than commercial and residential. The electric power industry will increase capacity by 8 per cent, representing approximately 12 million kilowatts.

Plans Firming for Fourth Automation Conference

RETAINING the program objective of previous conferences—to provide an integrated series of technical sessions covering up-to-date information on the fundamental and practical aspects of industrial automation—the planning committee for the Fourth Conference on Manufacturing Automation has completed preliminary action to assemble top speakers from diverse industries. Co-sponsored by the Schools of Mechanical Engineering and Industrial Engineering of Purdue University and the editors of AUTOMATION, the technical conference will be held at Purdue University on April 11-13, 1960.

Opening the conference sessions will be a panel discussion on *Engineering Costs—Who Pays?* More and more, manufacturers are coming to realize that significant competitive advantages can be gained only through the acquisition and use of specially engineered automatic production equipment embodying new concepts. It is an inescapable reality, however, that pioneering new equipment and methods can entail high development and debugging costs. Proper allocation of these costs between buyers and builders, and establishment of areas of responsibility for each group, are of vital importance. The panel, including experts from both buyer and builder industries, will present their thoughts on the equitable division of these burdens.

Other subjects to be featured include process analysis and machine procurement, handling in process and distribution, selection and application of temperature controls, and using relay control effectively. Final details of the conference program will be announced in future issues of AUTOMATION.

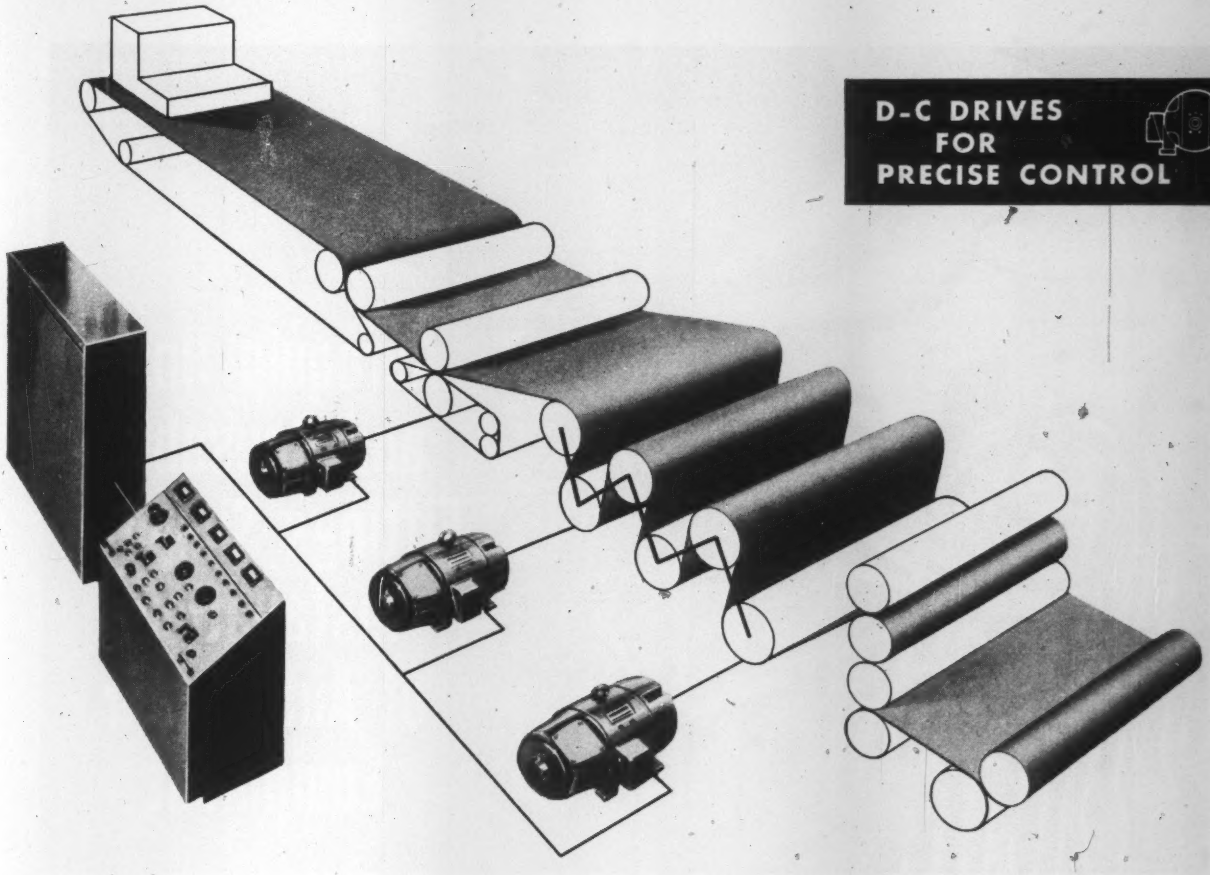
Esso Research and Engineering Moves Into New Home

SCIENTIFIC center which will be devoted to engineering and oil processing research has been officially opened by Esso Research and Engineering Co. at Florham Park, N. J. At the present time, the center consists of three buildings located on a 675-acre tract.

The center will serve as headquarters for a corps of engineers and scientists who plan and design Esso refineries around the world and develop new refining processes for the future. One of the three facilities on the tract is a process research building which has a central bay almost 4 stories high for conducting both large and small-scale process experiments. Another building contains a Computing Center equipped with an IBM 704 computer having a magnetic-core memory capacity of 32,000 words.

At the dedication ceremonies, **Marion W. Boyer**, director of Standard Oil Co. (New Jersey), stated that one of the most dramatic developments in recent years is the rapid growth of industrial research

D-C DRIVES FOR PRECISE CONTROL



Problem: How to coordinate two or more machines for greater production flexibility, lower costs

Operating at high speeds, working to close tolerances, meeting high-quality standards, today's machines must be controlled accurately. This is one of the reasons users and designers are making greater use of direct-current drives for coordinating two or more machines in multi-section process lines.

MACHINE COORDINATION IS A NATURAL JOB FOR DIRECT-CURRENT POWER. For direct current can best provide the accurate speed matching and extra measure of control needed for high-speed, automatic continuous processing.

D-c's flexibility allows each individual drive motor to be run at the exact speed demanded by the section of the process it drives. Increased output, better quality control and production flexibility lower the cost per unit of production.

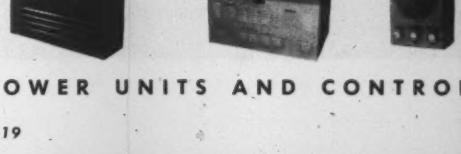
To learn more about the modern capabilities of direct-current power, write for your free copy of "WHY D-C?", *Section 829-3, General Electric Company, Schenectady 5, New York.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

SELECT FROM GENERAL ELECTRIC'S COMPLETE LINE OF D-C DRIVES

MOTORS AND GENERATORS



POWER UNITS AND CONTROLS

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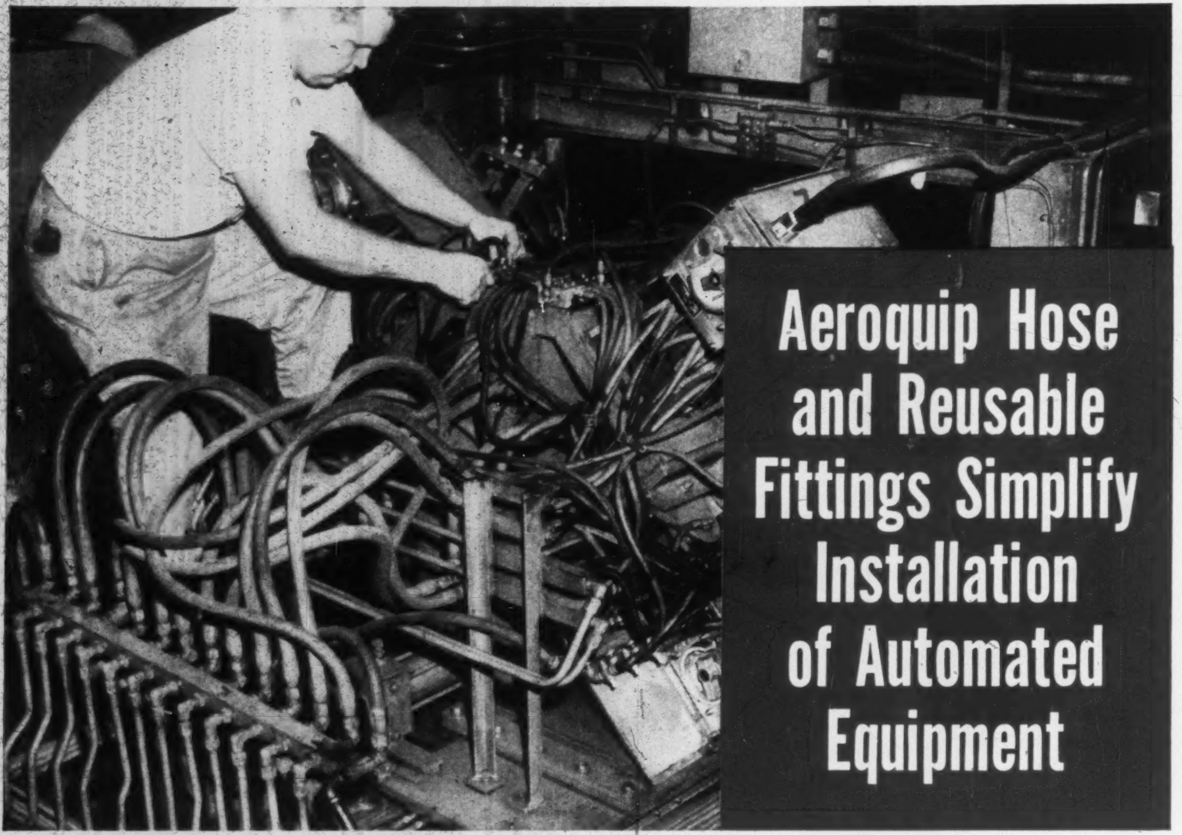


Aeroquip Hose and Reusable Fittings Simplify Installation of Automated Equipment

Aeroquip Hose Lines can be made to any required length. They assure quick, easy installation and routing of hydraulic lines.

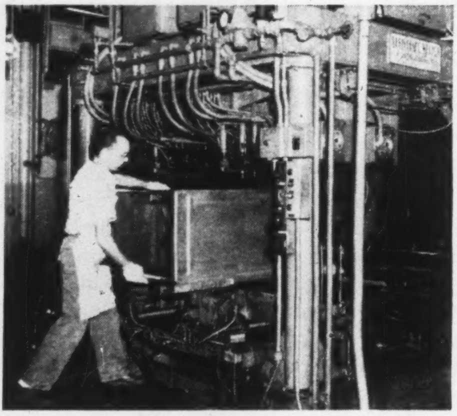
Aeroquip Hose and Reusable Fittings are ideally suited for application on automated equipment for three important reasons:

They meet all installation requirements—With a small inventory of Aeroquip Bulk Hose and Reusable Fittings, flexible hose lines of any length can be made up and installed quickly, easily.

They assure dependable operation—Because Aeroquip Flexible Hose Lines are rugged and durable, they help reduce machine downtime, maintain production schedules.

Quick, low-cost maintenance—Aeroquip Reusable Fittings are designed to be used over and over again to make up replacement hose lines as needed, greatly reducing hose line maintenance costs.

For valuable help by a hose line specialist, call your Aeroquip Distributor. He's listed under "Hose" in your Yellow Pages.



On this high production welding machine, designed and manufactured by the Resistance Welder Corporation, Bay City, Michigan, Aeroquip Hose Lines are used in hydraulic positioning of range bodies for welding.

Aeroquip

REG. TRADEMARK

AEROQUIP CORPORATION, JACKSON, MICHIGAN

INDUSTRIAL DIVISION, VAN WERT, OHIO • WESTERN DIVISION, BURBANK, CALIFORNIA
AEROQUIP (CANADA) LTD., TORONTO 19, ONTARIO
AEROQUIP PRODUCTS ARE FULLY PROTECTED BY PATENTS IN U.S.A. AND ABROAD

Circle 659 on Page 19

into a multibillion dollar venture. He estimated that there are more than 5000 industrial laboratories in the United States. When Esso Research originated in 1919 there were only approximately 290 industrial laboratories existing. According to Boyer, research and engineering technology are reducing capital costs by about 5 per cent per year. In the case of his company, this would amount to about $25 million yearly.

GLASS-LINED pipe manufactured by Pfaudler Co., Div., Pfaudler Permutit Inc., can be easily cut to size and threaded in the field by regular installation and maintenance crews. The only special equipment items required to handle the new product are threading dies and a small fire-polishing furnace. Available in 1½, 2, and 3-inch diameters, the pipe is used where corrosion and abrasion resistance are required, and to provide freedom from product contamination or adhesion.

Airborne System Circuits Checked In 20 Minutes

AUTOMATIC ground support equipment for an Air Force system development project, awarded recently to Airborne Instruments Laboratory, Div., Cutler-Hammer Inc., will be developed by Sperry Gyroscope Co. Sperry is one of eight contractors working as a team under management of Airborne Laboratory on development of a complete system of "very advanced" airborne electronic equipment.

Sperry's responsibility for ground support equipment introduces some of the most advanced test concepts known, including rapid automatic checkout systems and several new types of automatic and semiautomatic "package" testers. The automatic checkout equipment will be capable of testing and troubleshooting an entire airborne system automatically in less than 20 minutes. If done manually, the same series of tests would require several days.

The automatic tester will be housed in a small trailer which can be towed alongside and plugged into an aircraft on a flight line. By pressing a button, the operator in the trailer can start the complete series of rapid automatic checkout procedures which will test the readiness of hundreds of complex circuits in the airborne system.

Go/No-Go panel lights in a master console will monitor rapid progress of the automatic tests. At the completion of the checkout, the tester will give a *Go* signal indicating that the aircraft is ready to begin its mission. Where operation of any circuit is below an acceptable level, the tester will automatically pinpoint the faulty units and flash their exact identification on an indicator screen. This information will inform the operator immediately which plug-in units must be replaced before the aircraft can begin its mission.

Console Translates Data Into Plain Language

CONTROL and display console which enables anyone to operate a computer, and which interprets data in nontechnical language, has been developed by Intellectronics Laboratories, Ramo - Wooldridge Div., Thompson Ramo Wooldridge Inc.

The console can be connected to any data processing system. Through the use of a simple keyboard arrangement, operators may control the computer and demand

---

Teaching Machine Paces Students' Learning Rates

AUTOMATION of certain aspects of teaching is a step closer with the advent of a training device developed by Western Design, Div., U. S. Industries Inc. The instructorless unit incorporates a degree of communication with the student, in that it can adapt to his learning rate. The device is applicable in in-industrial training programs for the instruction of technicians and others.

The console-type machine includes a film bank accommodating up to 10,000 frames of instructional material, automatic sequence and projection apparatus, selector buttons, and a viewing screen. A tape printing mechanism is included to record each student's progress.

In operation, a student begins by entering the Number 1 on the keyboard of the console. With this action, the first unit of information to be taught appears on the screen, along with a multiple-choice question. Each answer to the question is identified by a different number. The student reads the material presented and then selects his answer to the multiple-choice question by entering its number on the keyboard. The corresponding film bank frame is then projected on the screen, giving a discussion of the answer selected.

If the answer is correct, the device acknowledges the fact and supplies the student with the next unit of information and another question. If the answer is incorrect, the image on the screen tells him so, explains why, supplies additional material to correct the error, and instructs the student to return to the first image and try again.

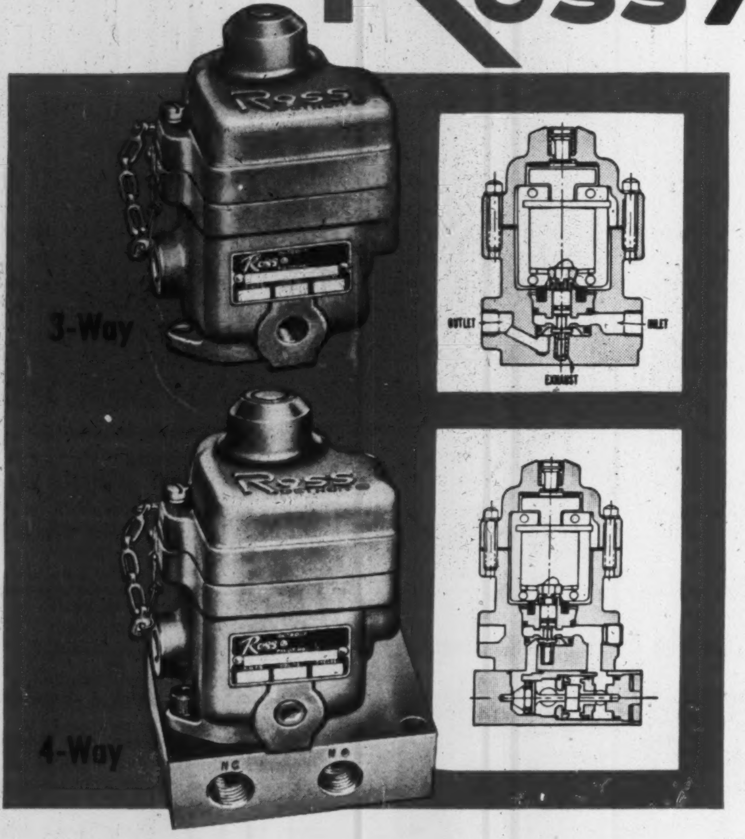
In effect, the machine develops knowledge of a subject step-by-step, at each student's pace, making sure that each unit of information is grasped completely. For evaluation purposes, the machine records the images viewed by the student, and the time spent on each.

Developers of the training machine emphasize that it will not replace creative teachers. Instead, it assumes the burden of imparting information at each student's pace, freeing the teacher for his creative function.

Announcing

a new and better solenoid valve in the $\frac{1}{8}''$ and $\frac{1}{4}''$ size range

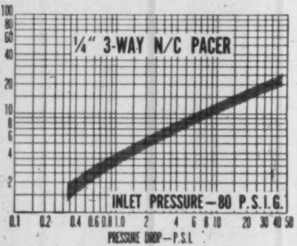
ROSS *PACER*



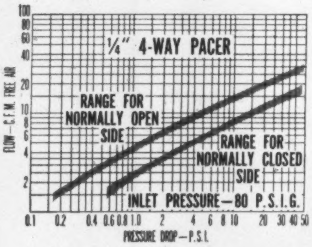
More life
More speed
More capacity
More value

Now you can have about three times more flow capacity-to-solenoid size than in most competitive valves. Needs just 7 watts of power yet minimum internal orifice size is full $\frac{5}{32}''$. The PACER has short poppet travel, will cycle at better than 1000 cpm and meets JIC specifications. Lightweight, cast aluminum body means 3-way weighs just 20 ounces, 4-way just 28. Dust tight, liquid tight, can be manually actuated, has captive cover, is inoperative with cover removed, has integral wiring space. Why not test a PACER in your own circuit, just $18 for a 3-way, $26 for a PACER 4-way. Call your Ross representative or write for Bulletin 319.

Pressure drop thru 3-way N.C. Pacer valve under steady flow conditions. Inlet pressure 80 psig. Data shown as a range rather than as absolute values due to variables such as barometric pressure, manufacturing tolerances, etc.



Pressure drop thru both N.C. & N.O. sides of 4-way Pacer valve under steady flow conditions. Inlet pressure 80 psig. Data shows ranges for each side rather than absolute values due to variables such as barometric pressure, manufacturing tolerances, etc.



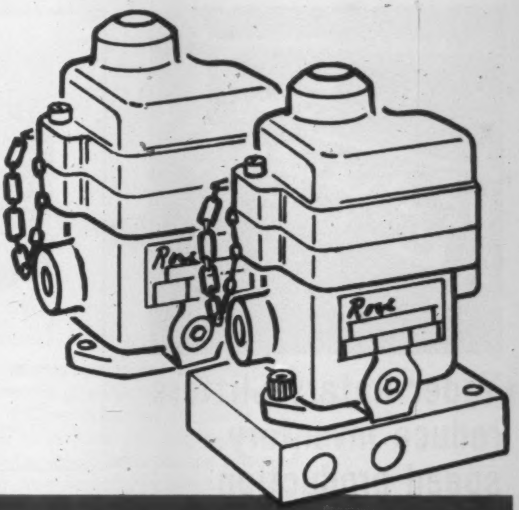
STAY AHEAD

MODERNIZE

ROSS OPERATING VALVE COMPANY
131 EAST GOLDEN GATE AVE. • DETROIT 3, MICH.

The Ross PACER gives you 56 new solenoid air valves

The Ross PACER is a fine new solenoid valve in the 1/8″ and 1/4″ size range that gives a full 5/32″ flow capacity yet uses only 7 watts of holding power. The PACER is built for especially long life yet is priced surprisingly low. Capable of 1000 cycles per minute and more, is JIC, and very light and compact. And if you're interested in large valves the PACER has a second identity, that of a pilot section to actuate *any* valve of the Ross Skyline series. It will operate any of these valves at top speed and with low power consumption.

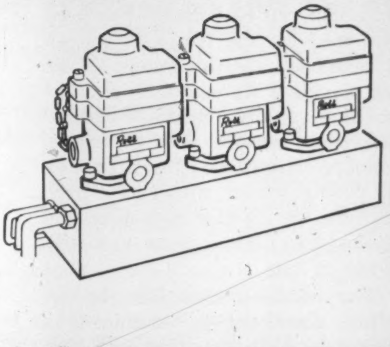


As well as being a complete new valve

. . . PACER is also a new pilot section in the Ross Skyline valve series . . .

	PIPE SIZES						
COMPLETE PACER VALVES	1/8″	1/4″	3/8″	1/2″	3/4″	1″	1 1/4″
STRAIGHTWAY, N/C	√	√					
3-WAY, N/C	√	√					
4-WAY	√	√					
SKYLINE VALVES USING PACER AS ACTUATOR (HEAD)							
STRAIGHTWAY, N/C		√	√	√	√	√	√
STRAIGHTWAY, N/O		√	√	√	√	√	√
3-WAY, N/C INLINE MT.		√	√	√	√	√	√
3-WAY N/O, INLINE MT.		√	√	√	√	√	√
3-WAY, N/C, BASE MT.		√	√	√	√	√	√
3-WAY, N/O, BASE MT.		√	√	√	√	√	√
4-WAY, INLINE MT.		√	√	√	√		
4-WAY, BASE MT.		√	√	√	√	√	√
4-WAY, 5-PORT		√	√	√	√		

New **PACER** manifolds to save piping and wiring



Ross manifolds provide a compact and economical method of multiple mounting PACER valves. One air supply line and one electrical conduit can serve all PACER valves. Manifolds are available in two and three stations.

STAY AHEAD

MODERNIZE

Ross OPERATING VALVE COMPANY

131 EAST GOLDEN GATE AVE. • DETROIT 3, MICH.

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Yoder Rotary Slitters reduce inventory... speed production

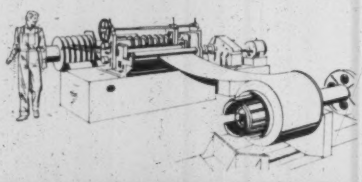
To help meet the demands of tight production schedules, YODER Slitters reduce mill-width stock quickly and economically to desired widths. If your needs are as low as 100 tons per month, time and manpower savings alone will offset the cost of your YODER Slitter in a matter of months, while reducing basic inventories. Compactly designed, standard YODER Slitters are built to handle standard coil widths . . . completely engineered lines for special requirements.

YODER accessories, such as coil cars, swivel unloaders, scrap choppers, scrap disposers, plate levelers and coil boxes, make stock handling fast and easy.

YODER also makes a complete line of Cold Roll-Forming equipment and Pipe and Tube Mills. To profit from YODER'S years of engineering and service experience, contact your local YODER representative or send for the YODER Slitter Manual.

Investigate the many advantages of YODER-engineered Slitter Installations. Write today for this comprehensive, 80 page YODER Slitter Manual . . . it's yours for the asking!

THE YODER COMPANY
5526 Walworth Avenue • Cleveland 1, Ohio



ENGINEERING YODER MANUFACTURING

ROTARY SLITTING LINES

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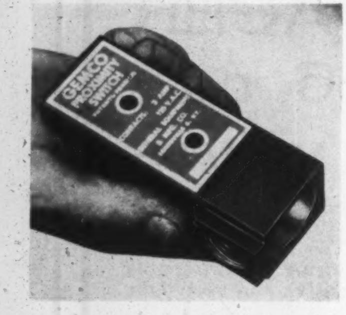

PROXIMITY limit switch developed by General Equipment and Mfg. Co. combines the characteristics of both a mechanical limit switch and a proximity type sensing system. The unit consists of an armature, carrying sets of silver contacts, which is positioned by the field of two magnets. One set of contacts is held normally closed by the force of one magnet while the other set of contacts is held normally open. The second magnet provides a contra-biasing force which is not quite capable of moving the armature. When a ferrous part is moved into the magnetic field of the normally closed side, sufficient flux lines are diverted from the field so that the biasing force of the second magnet becomes the larger force and snaps the armature, opening the closed contacts and closing the open contacts. When the part is removed, the forces revert back to normal, and the first magnet causes the armature to snap back to its original position.

a display of data either in graphic or printed form on the console's video screens. In effect, the operator may search the computer to which the console is connected in his own language and receive the answer in his own language.

As an example of its use in a bank loan application, the console can provide the loan officer with rapid access to all loan data in the computer's files. The officer would be able to run a complete credit check on an applicant. This information would then be displayed on the screen of the console for analysis and decision making by the officer. Industrial applications for the control and display console include inventory control, sales forecasting, and production scheduling.

Machine Copies Microfilm Frames Moving at 2400 Pages Per Min.

IMPROVED model of an automatic document retrieval device has been developed by the National Bureau of Standards for the Patent Office and the Navy Bureau of Ships. The machine rapidly retrieves information from massive files of correspondence, drawings, patents, or similar printed matter which have been recorded on 23 mm microfilm and photographs desired items on a strip of recopy film.

The machine identifies the required document by examining a binary dot code associated with each document. The code frame is about $1/4$ inch long and as wide as the film. It contains 6 rows of 46 bits each, with 40 bits required for document information and 6 bits needed for machine control. The mechanism that reads these rows of bits has sufficient tolerance to allow for normal dimensional changes in the film and slight skew in the rows.

As the film passes through the machine at a rate of about 2400 pages per minute, the code image is projected on a bank of photoelectric cells for scanning. When a desired item is found, a high-speed clutch mechanism is activated. This clutch presses a recopy film against a drive drum, accelerating it to the same speed as the information or master film. By means of slit photography, the desired item on the master film is registered on the recopy film. After the desired item passes the camera slit, the clutch is disengaged and the recopy film stops. As many consecutive items as desired can be copied without slowing or stopping the master film.

New Firm To Tackle Unsolved Lube Problems

ESTABLISHED for the express purpose of developing solutions for industrial lubrication and protective coating problems in boundary areas, Almasol Corp. has been formed as a subsidiary of Lubrication Engineers Inc. Two types of services will be rendered by the new organization. First, the group will make available the products and processes previously developed (See AUTOMATION — June 1959, p.

around the triangle

QUICK-CHANGE VALVES FOR INDUSTRY

Here's an idea that could reduce maintenance time in automated processing systems. Allis-Chalmers Mfg. Co. has developed a model of a cartridge type butterfly valve which can be quickly and easily serviced without removing the valve body from a pipe line. The valve bonnet holding the valve vane and seat assembly is bolted onto the valve body. Readily accessible bolts enable maintenance personnel to quickly replace the cartridge assembly with a new assembly without removing the valve body from the line. It is proposed that the valve be manufactured in sizes from 6 to 48 inches.

FOR THOSE BIG JOBS . . .

Largest press ever built for the Hidraw forming process has been constructed for Union Carbide Nuclear Co. by the Hydraulic Press Mfg. Co. The hydraulic press has a 7500-ton downward-acting slide with a 60-inch stroke and is equipped with a 6750-ton die cushion with a 26-inch stroke. Pressing area is 72 by 144 inches. It has a maximum closing speed to work and return speed of 600 inches per minute. Pressing speed to full tonnage is from 4½ to 47½ inches per minute. All speeds are infinitely adjustable. Electrohydraulic servo controlled work loading tables are part of the press equipment. Sequencing of the table in and out of the press is completely automatic as part of the press cycle.

NEMA ELECTS NEW SLATE OF OFFICERS

New officers have been elected for 1-year terms by the National Electrical Manufacturers Association. Included are N. J. MacDonald, president of Thomas & Betts Co., as NEMA president; W. C. Wichman, vice president of General Electric Co., as vice president; A. D. R. Fraser, president of Rome Cable Corp., as treasurer.

NEW CONCEPT PROMISES FASTER COMPUTER MEMORIES

Thin magnetic metal films may provide the key to making high speed computer memories work even faster according to Dr. Richard W. Hoffman, associate professor of physics at Case Institute of Technology. The films, as thin as 50 atoms, are prepared by evaporating metals such as iron, nickel, and their alloys in a vacuum. The films develop from small centers that eventually grow together. Although made of single crystals or collections of single crystals, the films have extremely imperfect structures, with many atoms irregularly aligned. This makes them resistant to the passage of electrical currents. Below certain temperatures, the films may become spontaneously magnetized. Furthermore, the magnetic patterns in the films can be changed very rapidly. When this is done, small voltages are generated which can provide signals for a computer. This property makes such films of great potential value as high speed memory elements.

CROSS-FERTILIZATION CUTS COSTS

Fast, simple method for laying small diameter aluminum pipe has been developed by Aluminum Co. of America and a major oil company in co-operation with American Tractor Equipment Co., C. V. Miller Construction Co., and Colorado Builders Supply Co. In a recent test, automatic pipe-laying equipment dug a 42-inch deep trench, unreeled and laid 2-inch schedule 5 aluminum pipe, and back-filled the trench in one continuous operation at a rate of 3 miles per hour. Adapted from a method commonly used to bury communication cables, the setup included a tractor carrying coiled pipe and a plow having a curved, hollow blade. As the plow dug a trench, the pipe passed through the blade, straightened out on the trench bottom, and was covered with earth. According to Alcoa officials, the installed cost of aluminum pipe placed by the process is one half that for steel pipe used for similar applications.

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AUTOMATION

Information Service

For your convenience, advertisements and items of information on new equipment, components and manufacturers' literature can be quickly identified by an *Item Number* accompanying each unit.

For additional free information circle item number on an inquiry card. Fill in your name, title, address, etc.—Drop it in the mail—Your request will receive prompt attention and will be filled directly by the manufacturer.

AUTOMATION **January, 1960**

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401	441	481	521	561	601	641	681	721	761	801
402	442	482	522	562	602	642	682	722	762	802
403	443	483	523	563	603	643	683	723	763	803
404	444	484	524	564	604	644	684	724	764	804
405	445	485	525	565	605	645	685	725	765	805
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416	456	496	536	576	616	656	696	736	776	816
417	457	497	537	577	617	657	697	737	777	817
418	458	498	538	578	618	658	698	738	778	818
419	459	499	539	579	619	659	699	739	779	819
420	460	500	540	580	620	660	700	740	780	820
421	461	501	541	581	621	661	701	741	781	821
422	462	502	542	582	622	662	702	742	782	822
423	463	503	543	583	623	663	703	743	783	823
424	464	504	544	584	624	664	704	744	784	824
425	465	505	545	585	625	665	705	745	785	825
426	466	506	546	586	626	666	706	746	786	826
427	467	507	547	587	627	667	707	747	787	827
428	468	508	548	588	628	668	708	748	788	828
429	469	509	549	589	629	669	709	749	789	829
430	470	510	550	590	630	670	710	750	790	830
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433	473	513	553	593	633	673	713	753	793	833
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435	475	515	555	595	635	675	715	755	795	835
436	476	516	556	596	636	676	716	756	796	836
437	477	517	557	597	637	677	717	757	797	837
438	478	518	558	598	638	678	718	758	798	838
439	479	519	559	599	639	679	719	759	799	839
440	480	520	560	600	640	680	720	760	800	840

AUTOMATION **January, 1960**

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14). Secondly, it will conduct, on request, original research on new lubrication and protective coating problems. New products and processes will be developed where necessary.

Typical problem areas for which products have been developed include those where parts needing lubrication must be sealed up or located at inaccessible places; where high temperatures and/or high pressures make conventional lubricants or protective coatings ineffective; and where contamination problems are such as to preclude the use of regular lubricants. A special drawing compound, using Almasol in a liquid carrier, has also been developed.

Continuous Extrusion Process Forms Polyethylene Netting

EXTRUSION process capable of forming polyethylene netting in one continuous operation has been reported by U. S. Industrial Chemicals Co., Div., National Distillers & Chemical Corp. A special reciprocating die cross-extrudes polyethylene filaments, welding them together at points of contact while the resin is still molten.

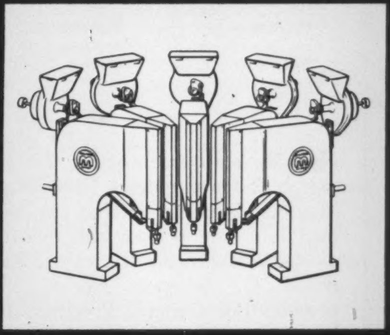
The filament junctions are said to be stronger than if they were formed by heat sealing. Nets may be produced in tubular form and in widths up to 36 inches, with mesh openings from very fine to fish-net coarseness. The netting manufacturer is also developing an automatic bag machine for packaging vegetables and other produce in the new material.

SPOTLIGHTING PEOPLE

Lynn C. Holmes appointed director of engineering operations and **Dr. Nisson A. Finklestein** named assistant vice president and director of research for Stromberg-Carlson, Div., General Dynamics Corp. . . . **Eugene A. Cook Jr.** appointed chief engineer of Selas Corp. of America. . . . **Charles D. Manhart** elected vice president at Daystrom Inc. . . . **Bruce Johnson** named manufacturing manager for Helipot Div., Beckman Instruments Inc. . . . **Kermit Kuck** appointed executive vice president of Monarch Machine Tool Co. . . . **Dr. Harry**

NEW "BUILDING BLOCKS"

. . . for automatic riveting

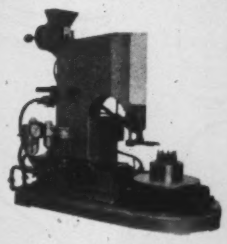


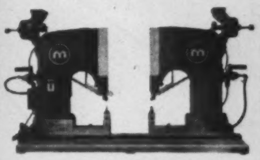
Milford's Models 56 and 57 offer unlimited flexibility in automatic assembly

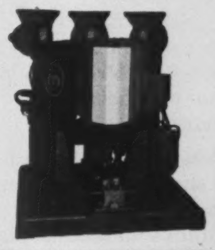
The narrow wedge shape of Milford's new air-actuated riveters permits unusually close riveting. Both models can be combined with sliding-fixtures, indexing tables or similar attachments to give greatest flexibility of assembly. Air-operated toggle action assures fast and safe action. Model 56 handles tubular rivets from ⅛" diameter x ⅝" length; Model 57 from 3/16" diameter x 3/4" length.

Group these new "Building Blocks" to suit your own production needs. Use them singly, in pairs, in threes, fours or even fives. Multiple riveting is the newest answer to reducing production costs.

For more new ideas, tips and technical data on tubular rivets and rivet-setting machines, ask your Milford Representative for a look at Milford's new MANUAL OF MODERN RIVETING PRACTICE.







THE MILFORD RIVET & MACHINE CO.

MILFORD, CONNECTICUT • HATBORO, PENNSYLVANIA
ELYRIA, OHIO • AURORA, ILLINOIS • NORWALK, CALIF.

Circle 662 on Page 19

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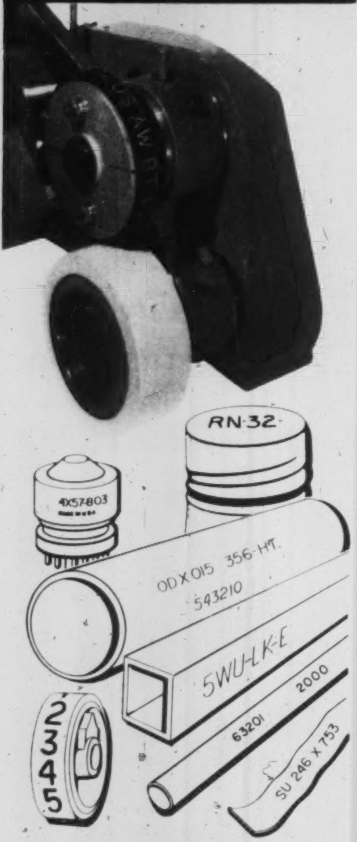
OFFSET
PRINTERS
Speed Production



You get economy, speed, and the highest quality marking on your products with a Matthews Offset Printer adapted for *your* product, and designed for *your* production.

Printers may be installed to print shapes, sheets, bars, extrusions, wire, etc., with the proper inks for metals, plastics and fabrics.

Write today, stating your marking requirements.

JAS. H. MATTHEWS & CO.
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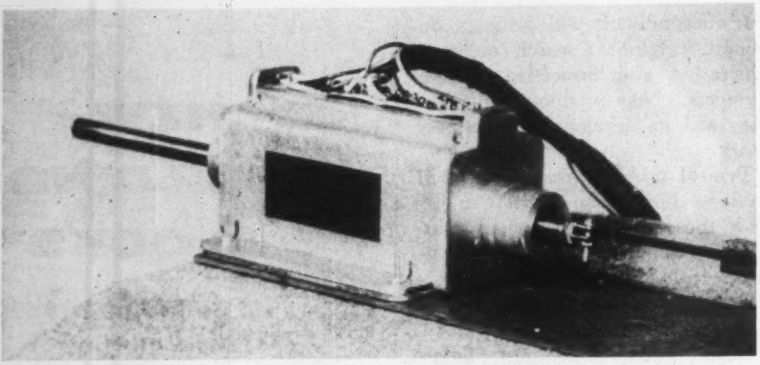

SHAFT of linear positioning motor developed by Tronics Corp. moves to predetermined, discrete positions in response to input commands from pushbuttons, switches, relays, or digital devices. Up to 80 positions may be selected in one model having a 10-inch stroke. When an input is received, the shaft moves rapidly toward the selected position, then decelerates and stops. Repeatibility within 0.005-inch is possible. Operating on dc, units can provide thrusts up to 100 pounds for applications such as signaling, operating valves, and feeding drills to controlled depths. Shaft is free to move axially with the motor de-energized; it may be rotated at any time.

Nyquist, staff scientist in the Research & Development Div., W. L. Maxson Corp., to receive the 1960 medal of honor from the Institute of Radio Engineers Inc. . . . **Raymond G. Johnson** elected vice president of General Precision Laboratory Inc., subsidiary of General Precision Equipment Corp. . . . **Alfred C. Haemer** appointed manager of electronic equipment manufacturing at Farrington Mfg. Co. . . . **Derio Dalasta** named head of the Static Relay Section, Switchgear Department, Allis-Chalmers Mfg. Co. . . . **Milton R. Watco** appointed chief engineer of Ransohoff Co. . . . **Joseph L. Duzan** appointed assistant to the general factory manager, Bearing & Rock Bit Divs., Timken Roller Bearing Co. . . . **James J. Kelly** named assistant to the vice president-manufacturing at Taylor Fibre Co. . . . **Martin B. Weiner** and **John L. Urgo** appointed vice presidents of Auburn Mfg. Co. . . . **Robert L. Chyrchel** appointed staff vice president with responsibility for manufacturing planning and development for all present divisions and subsidiaries of Bell & Howell Co. . . . **William M. Semple** has been named director of manufacturing for U. S. Semiconductor Products Inc. . . . **William I. Ballentine Jr.** appointed chief engineer of Southern Pipe Div., U. S. Industries Inc. . . . **Dr. John M. Salzer** named to head the new Intellectronics Laboratories, a new unit of Ramo-Wooldridge Div., Thompson Ramo Wooldridge Inc. . . . **Burton Swirsky** appointed chief engineer of Spectrol Electronics Corp. . . . **Rudolph A. Rieder** named operations manager of the Data Systems Dept., Norden Div., United Aircraft Corp. . . . **Norden E. Hull**, vice president and general manager of Hughes Gun Co. and assistant to the vice president-manufacturing, of Hughes Tool Co., has been nominated for the office of president of the National Society of Professional Engineers.

SPOTLIGHTING PLANTS

Servocontrol, a division of Oilgear Co., has transferred operations to a new plant in Waltham, Mass. The modern facility includes electronics and hydraulics laboratories, a machine shop, model shop, and drafting area for the design, construction, and testing of electrohydraulic servo components and complete servo systems. . . . **General Controls Co.** has established an International Div., the function of which will be to supervise and co-ordinate the company's expanding overseas activities. Headquartered in the firm's home offices in Los Angeles, the new division will handle organizational arrangements, procurement, manufacturing, sales, licensing, and distribution of products in all areas outside the continental U. S. excluding Canada and Mexico. . . . **Radio Corp. of America** has announced plans to construct a new plant in the Washington, D. C.-Canonsburg, Pa. area. Facility will

Solve Your Adjustable Speed Problems with this Combination

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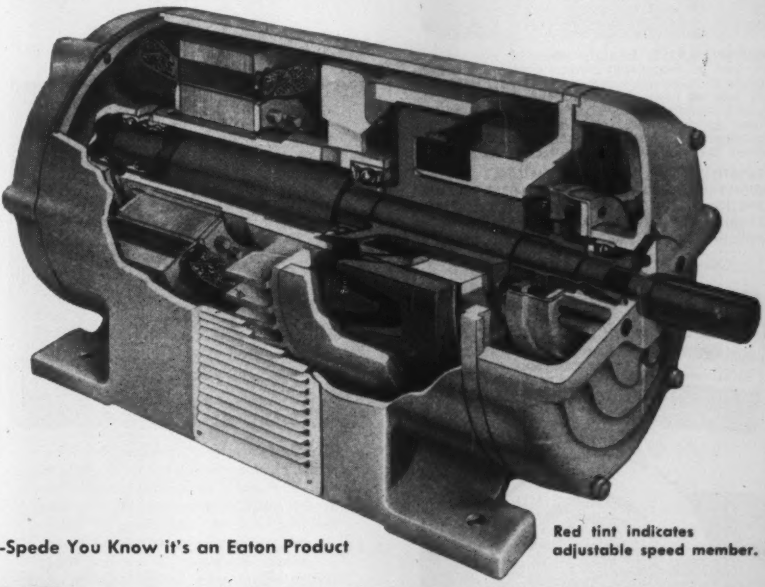
If your problem is in the field of speed control, tension control, power transmission, or testing, Dynamatic Eddy-Current Equipment is the ideal solution. Dynamatic Ajusto-Spede Drives, Couplings, Brakes, and Dynamometers are solving these problems in virtually every industry—in both plant machinery and end product applications. Dynamatic equipment can do the same for you.

Ajusto-Spede Drives and other Dynamatic units offer the important advantages of rapid response, wide speed range, quiet operation, low power loss, low maintenance costs, and stepless adjustable speeds from an AC power source.

For complete information about Dynamatic problem-solving equipment, check with your local Eaton-Dynamatic representative or distributor.

The New Quill-Type Ajusto-Spede Drive provides controlled adjustable speeds for applications from ½ HP through 7½ HP. Together with the new K-2 Electronic Control and push-button station, this new Ajusto-Spede Drive comprises a compact, low-cost, 3-unit drive package.

Send for Illustrated Descriptive Literature Covering New Models ACM-903 and 904 Ajusto-Spede Drives



Red tint indicates adjustable speed member.

*When You See the Name Ajusto-Spede You Know it's an Eaton Product

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PIONEER IN EDDY-CURRENT EQUIPMENT

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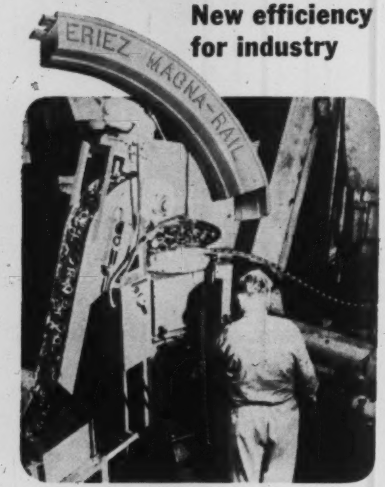
New efficiency for industry



MAGNA RAILS. Lifetime powered, non electric magnetic elements that convert ordinary belt conveyors to *magnetic* conveyor elevators. Will convey ferrous items up inclines as steep as 90° — quickly, safely, with positive hold. Easily installed under existing lines, or incorporated into new equipment. Increases production. Reduces manpower needs. Saves valuable factory floor space.

VERSATILE MAGNA RAILS ARE AVAILABLE IN MANY MAGNETIC STRENGTHS IN VARIOUS BOLT-TOGETHER LENGTHS AND IN STRAIGHT AND CURVED SECTIONS, ASSURING YOU PROPER UNITS FOR SOLVING YOUR HANDLING PROBLEMS REGARDLESS OF SIZE OF PARTS.

MAGNETS
for
AUTOMATION

We work closely with design engineers, OEMs, etc. Contact us any time.

FREE! Comprehensive "Belt Conveyor" portfolio. Complete info on magnetic components, applications, test data, installation photos, etc. Write today to Eriez Manufacturing Co., 119-AA Magnet Dr., Erie, Pa.

ERIEZ

Circle 665 on Page 19

be used to manufacture industrial electronic products including two-way radio systems and components for electronic data processing systems. . . . **Westinghouse Electric Corp.** is constructing a new, multimillion dollar power transformer plant in Muncie, Ind. Located on a 300-acre tract, the plant will provide 600,000 sq ft of floor space for the manufacture of large power transformers. Numerical control and other automatic techniques will be employed extensively in the new plant. . . . **Robertshaw-Fulton Controls Co.** has acquired the assets and business of Mairco Inc., manufacturer of automatic control devices. . . . **Midland-Ross Corp.** has acquired Surface Combustion Corp. and will operate it as a division. The new acquisition will continue to manufacture its regular line of products including process heating, furnace, and humidity control equipment, with no change in personnel. . . . **Fried Steel Equipment Mfg. Corp.** has concluded a licensing arrangement with Weldall & Assembly Ltd. of Stourbridge, England. The British concern will manufacture and sell Fried materials handling equipment on a worldwide basis, with the exception of the Americas and Canada. . . . **Automation Engineering Laboratory**, manufacturer of automa-

HOPPER activator developed by Vibra Screw Feeders Inc. employs a combination of motions to provide smooth flow of dry materials from hoppers and bins. Bridging, caking, and hang-up effects are said to be eliminated by the device. In normal operation, a vertical shaft, having radial arms at spaced intervals, is vibrated up and down in the material. Where stored materials do not respond to this action, the entire vibrating assembly may be reciprocated slowly up and down by an air cylinder. Strokes up to 1 foot are used, depending upon hopper size and the material to be fed.

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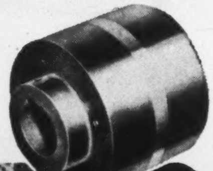

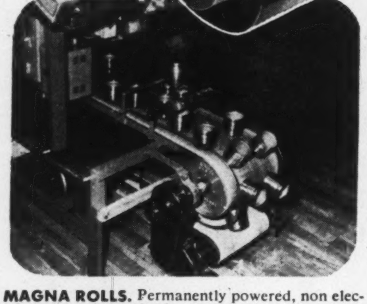

MAGNA ROLLS. Permanently powered, non electric automation units for use in magnetic conveying systems. Hold, control, elevate, change direction flow of ferrous materials – from small parts to large sheets. Can be used as head pulleys or in systems not utilizing belts. For *faster, shorter, safer* conveyor lines that move at peak speeds for peak production!

MAGNETIC STRENGTH IS GUARANTEED INDEFINITELY • NON ELECTRIC; NO WIRES, ATTACHMENTS, FUSES • NO MAINTENANCE • EASILY INSTALLED ON NEW OR EXISTING EQUIPMENT • LOW INITIAL COST; NO OPERATING COSTS • VARIOUS DIAMETER WIDTHS, STRENGTHS, CONTOURS, ETC., TO MEET SPECIFIC NEEDS.

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AUTOMATION

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Eriez Mfg. Co, 119-AB Magnet Dr., Erie, Pa.

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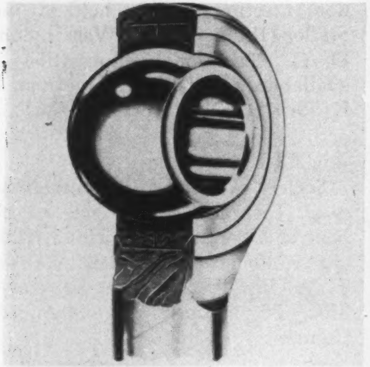


SELF-ALIGNING bearings and rod ends developed by Micro-Precision Div., Micromatic Hone Corp., require no lubrication. Useful in high-load, low-velocity applications, the bearings resist damage from contaminants, abrasives, and corrosion. Self-lubricating properties are imparted by a liner composed of a fabric woven with both glass and Teflon fibers. A second fabric of glass cloth impregnated with a phenolic, backing up the first, performs a bonding function and prevents movement of the glass fibers under load.

tion machinery for the food, paper, textile, hardware, and packaging industries, has contracted for the construction and lease of a new plant in Stamford, Conn. A major portion of the new facilities will be allocated to developments for the candy industry. . . . **American Meter Co.** has acquired all of the outstanding capital stock of the Granberg Corp., manufacturer of bulk plant and pipeline petroleum meters and pumps. . . . **F. Jos. Lamb Co.** has announced the construction of a plant addition in Detroit that will more than double its present machine assembly area and increase fabricating space by 25 per cent. . . . **SI Handling Systems Inc.** has opened a new product development center in Phillipsburg, N. J., which includes facilities for prototype manufacturing and testing of automated materials handling equipment for the warehousing, freight handling, and manufacturing fields.

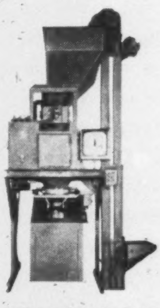
MEETINGS AND EVENTS

Jan. 11-13—

Sixth National Symposium on Reliability and Quality Control. Sponsored by the American Society for Quality Control, AIEE, IRE, and Electronic Industries Associa-

If you overweigh you lose money...
If you underweigh you lose customers!

Richardson Automatic Bagging Scales are the answer to this problem. They provide high speed bagging with accuracy that eliminates give-away of product, avoids customer complaints of shortweights. Higher production speeds mean reduction in costs, too.



The Richardson E-50 Bagging Scale gives you all these benefits –

Accuracy – within 1 ounce at speeds of ten or more 50-lb. bags per minute!

Versatility – handles weighings from 5 to 200 lbs. of grains, plastics, powdered and granular chemicals, feeds and meals, pellets, sugar, salt, and many others.

Dependability—ruggedly-built for years of trouble-free service.

For full details on the Richardson E-50 and other bagging scales write today.

Richardson Scales conform to U.S. Weights and Measures H-44 for your protection.

Here's the answer . . .

Richardson

MATERIALS HANDLING BY WEIGHT SINCE 1902

1790

RICHARDSON SCALE COMPANY • CLIFTON, NEW JERSEY

Sales and Service Branches in Principal Cities • Also manufactured in Europe to U.S. standards

Circle 667 on Page 19

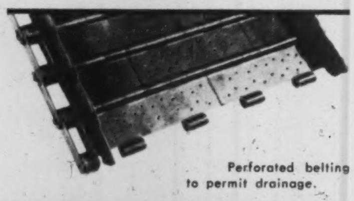
MAY-FRAN HINGED-STEEL BELT CONVEYOR SYSTEM SOLVES ANOTHER PARTS AND SCRAP HANDLING PROBLEM

54-500-144-90

PHOTO: In this automotive plant, two May-Fran hinged-steel conveyors are utilized to speed production and clear scrap from the working area. Scrap is taken from under floor area and carried to chute where it crosses belt carrying semi-finished parts. Combination chute and storage unit discharges load only when tote box is in position.

8714-MF

Belt equipped with side wings and plain surface.



Perforated belting to permit drainage.

Cleated belting prevents fall-back.

Pre-engineered for maintenance-free operation, maximum economy and long service life, the May-Fran hinged-steel belting has been developed especially for handling all types of heavy and rough materials. This belting is available in any width or length to meet individual job requirements. CUSTOMIZED conveyors can be supplied from stocked component parts. Installations can be made below floor level, flush with floor or above floor level.

Write today for Catalog MF-100

MAY-FRAN ENGINEERING, INC.
1761 Clarkstone Rd. • Cleveland 12, Ohio

Circle 668 on Page 19

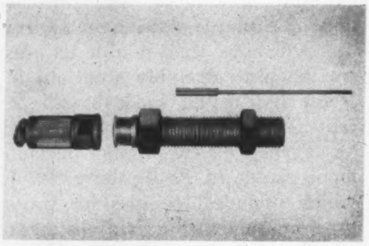
tion, meeting will be held at the Statler-Hilton Hotel, Washington, D. C. Additional information is available from IRE headquarters, 1 E. 79th St., New York 21, N. Y.

Jan. 12-15—
Society of Plastics Engineers. Annual Technical Conference to be held at Conrad Hilton Hotel, Chicago. For further details contact T. A. Bissell, Executive Secretary, SPE, 65 Prospect St., Stamford, Conn.

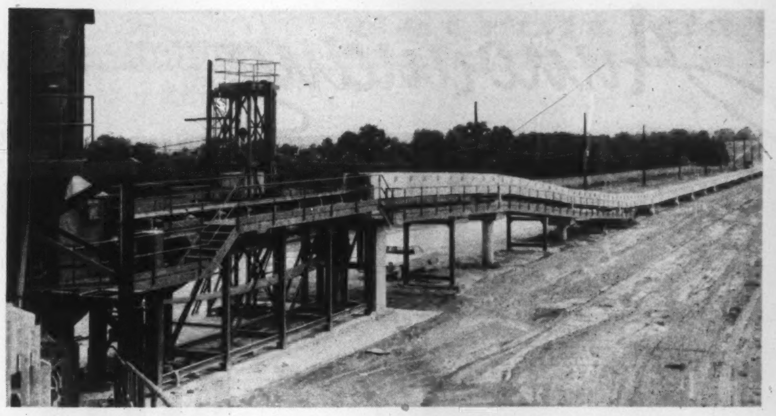
Jan. 25-28—
Institute of the Aeronautical Sciences. Annual meeting to be held at Hotel Astor, New York. Further information is available from IAS headquarters, 2 E. 64th St., New York 21, N. Y.

Jan. 25-28—
Plant Maintenance and Engineering Conference and Show. Eleventh annual conference and show to be held at Convention Hall, Philadelphia. Additional information is available from Clapp & Poliak Inc., 341 Madison Ave., New York 17, N. Y.

Jan. 26-27—
Society of Vacuum Coaters. Third Annual Meeting to be held at Hotel Biltmore, New York. Additional details obtainable from John H. Smith, Technical Services Dept.,



LINEAR displacements are converted to proportional electrical signals with variable-permeance type transducers manufactured by the Electronics Div. of Crescent Engineering & Research Co. Suitable for industrial measuring and control applications, the units feature stepless resolution, with 0.5 per cent maximum nonlinearity, for displacements up to 4 inches. Housings and movable elements of rugged instruments are steel; coils are encapsulated in epoxy resin to protect them against moisture and vibration. Used in bridge type circuits, the transducers operate with maximum ac inputs of 24v rms at a recommended frequency of 3kcps. Output is approximately 2/3 of input for full stroke displacement over rated range.



LONGEST single flight of rubber belting ever engineered into a conveyor system is used in one section of this overland transport system for conveying limestone and shale from a quarry to a new cement plant of Ideal Cement Co. The belt constructed by B. F. Goodrich Industrial Products Co., is used in a 12,000 foot conveyor section and contains 45 electrically vulcanized splices. Advantage of the single, long flight is that fewer belt drive motors and transfer devices are required than would be necessary with shorter belts. The system employs a total of 11 miles of B. F. Goodrich belting to keep 1000 tons of material in motion at 500 fpm over a 5½ mile course.

Consolidated Electrodynamics Corp., 1775 Mt. Read Blvd., Rochester 3, N. Y.

Jan. 31-Feb. 5—
American Institute of Electrical Engineers. Winter general meeting to be held in New York. Technical papers on control computers. Additional information is available from G. L. Hollander, Philco Corp., 4700 Wissahickon Ave., Philadelphia 44, Pa.

Feb. 1-5—
Instrument Society of America. Regional ISA Instrument-Automation Conference and Exhibit to be held at Houston Coliseum, Houston, Tex. For further information, contact William H. Kushnick, ISA headquarters, 313 Sixth Ave., Pittsburgh 22, Pa.

Feb. 2-4—
Society of the Plastics Industry Inc. Fifteenth Reinforced Plastics Division Conference to be held at the Edgewater Beach Hotel, Chicago. Further information is available from SPI headquarters, 250 Park Ave., New York 17, N. Y.

Feb. 3-4—
Midwest Welding Conference. Sponsored by the Armour Research Foundation and the Chicago section of the American Welding Society, meeting will be held at Illinois Institute of Technology, Chicago. Additional information is available from Harry Schwartzbart, Armour Research Foundation, 10 W. 35th St., Chicago 16, Ill.

Feb. 14-18—
American Institute of Mining, Metallurgical, and Petroleum Engineers. Annual Meeting to be held at Statler-McAlpin Hotel, New York. For further details contact AIME headquarters, 29 W. 39th St., New York 18, N. Y.

March 29—
Material Handling Institute Inc. Spring Meeting to be held at Hilton Hotel, Pittsburgh. For further information contact W. L. Redding, Hanson & Shea Inc., One Gateway Center, Pittsburgh 22, Pa.

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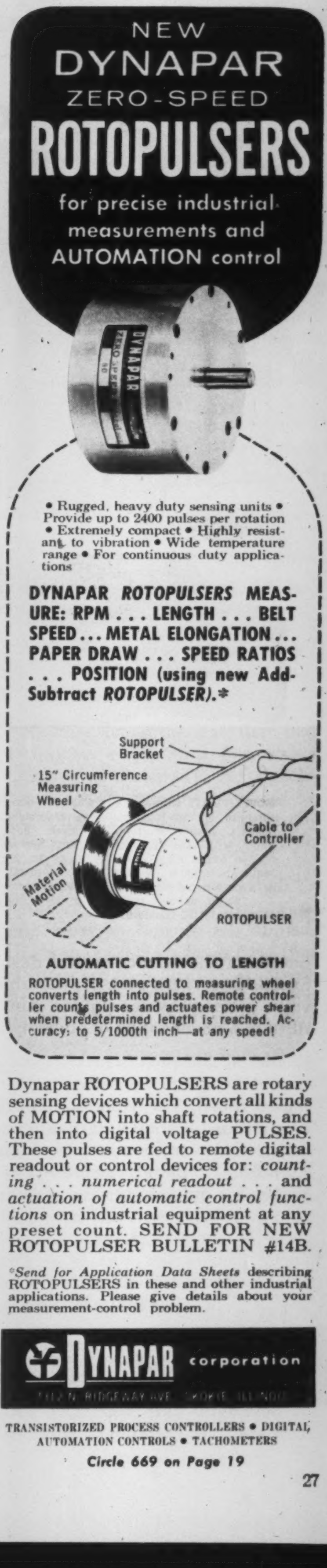
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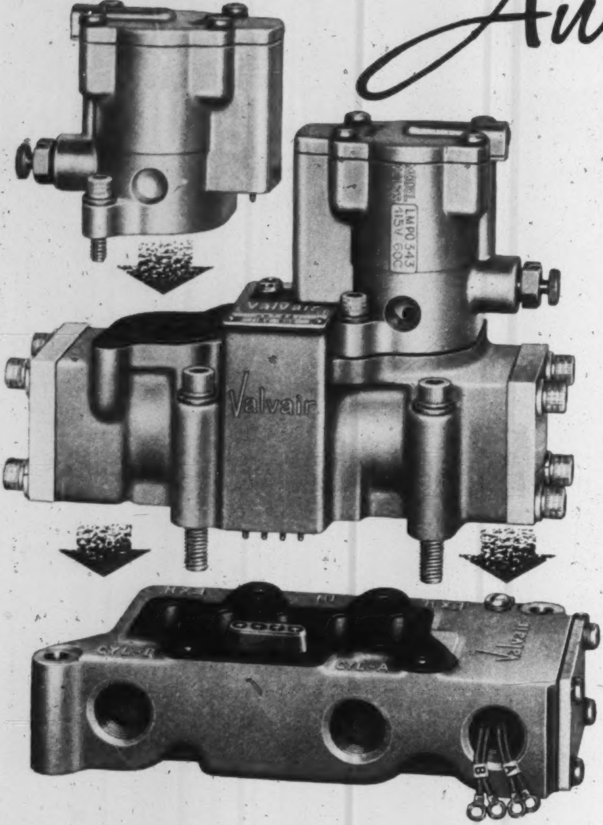
Circle 669 on Page 19



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8098

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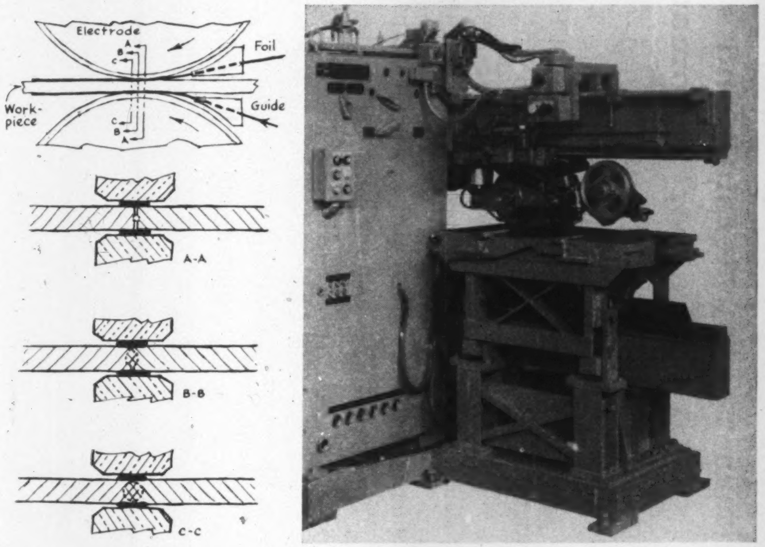
detroit dateline

By **JAMES C. KEEBLER** Managing Editor



Sketches illustrate formation of a weld by the foil seam process. Foil is accurately guided onto the joint between the rolling electrodes. At section **A-A** the welding current has produced sufficient heat to start the weld nugget at the center of workpiece. At **B-B,** pressure on the electrodes and pressure caused by expanding workpieces are acting on the confined weld metal, the nugget has grown, and the foil is beginning to imbed into the workpieces. At **C-C,** the pinch point of the electrodes, the nugget is fully across the workpieces and the pressure exerted through the foil has displaced sufficient material to fill the gap between workpieces. As the work leaves the wheels energy continues to flow into the joint, the nugget continues to grow and the foil-to-work interface becomes welded. The photo shows the offal salvage welding machine made for Ford's Dearborn Stamping Plant by Precision Welder and Flexopress Corp.

Rosy Glow for 1960

TRADITION dictates that in the first issue of the new year the readers of this column be reminded that, in the words of the late great Will Rogers, "I am at heart an optimist."

Happily enough, this optimism is phased in with the times and one does not have to search far for fuel to feed the carburetors of his "rosy-glow" machine. Yet, the past year's performance has shown that change can be more than inevitable. It can be rapid indeed.

When visiting the plants of the world of automaking which we dateline Detroit, the technical journalist can't help but record a reading on his "rosy-glow meter."

Last November when the steel strike had cut auto production, a tour through a GM plant in partial operation was like an excursion in a morgue. The gloom was heightened by the coldness of the place. The quickening pace of December's production schedules has the automakers glowing with optimism. This is a good atmosphere in which to ring in a new year and a new decade.

Who's Afraid . . .

An observer must extrapolate with care, and even the more enthusiastic optimists must be careful what they conclude about the universe on the basis of an admittedly small sample. However, one could expect to say without fear of successful contradiction that things look rosy for the automakers going into 1960.

For the nation as a whole the effects of the steel strike remain a big question mark. Some harbingers of doom have called attention to circumstances parallel to those that caused the doldrums of 1958. The story goes like this: In '57-'58 people stopped buying cars—the auto industry went down—the economy of the nation (so dependent upon auto prosperity) went down with it. In '59 the steel industry shut down—this took the auto industry down—will the economy of the nation (so dependent upon auto prosperity) therefore have a setback again?

It may be too early to tell, but it looks like your money is safe if you're betting on prosperity.

Of the Big Bad Wolf

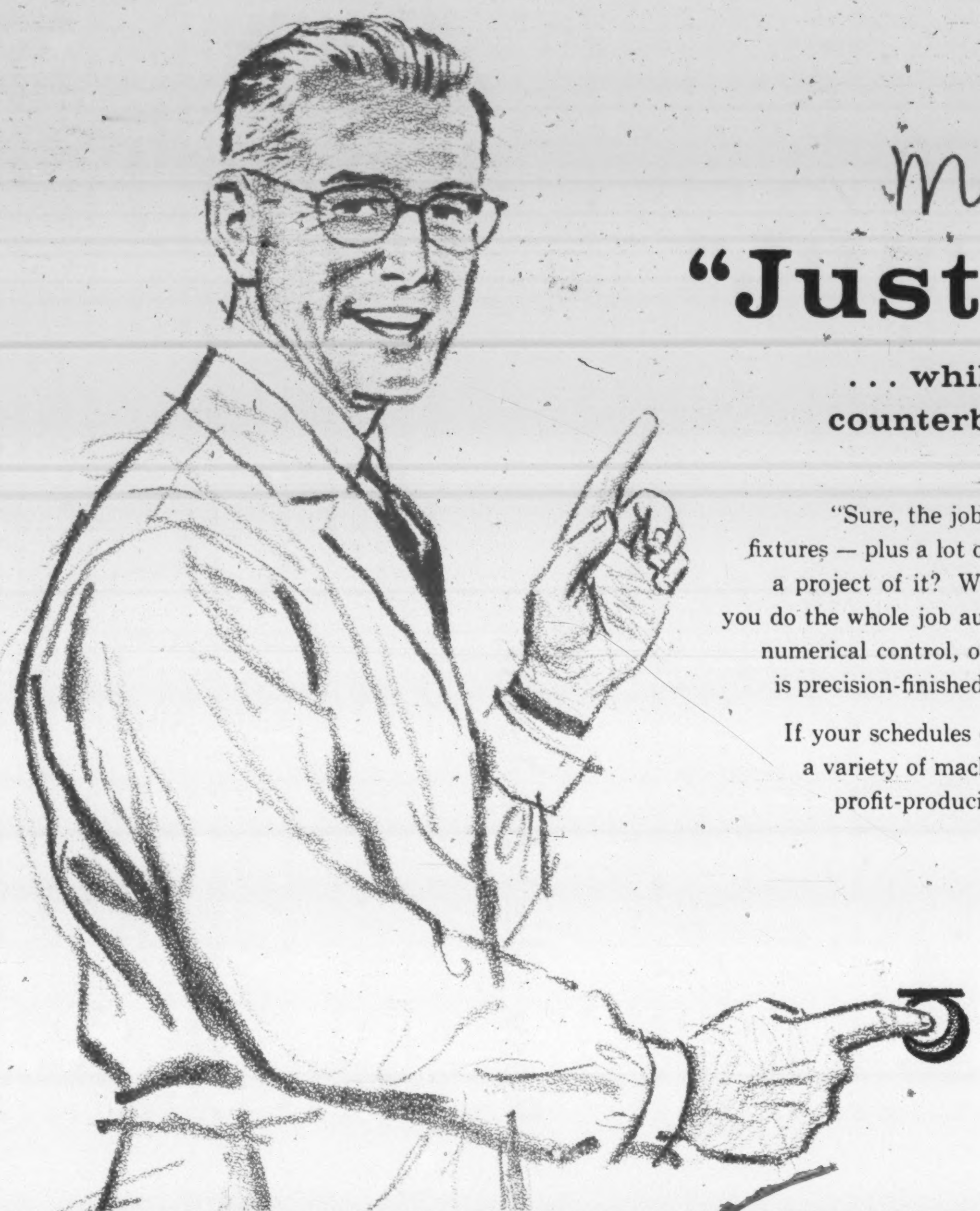
Another hangover fear that had it's origins when hard times were knocking at the door is the concern that we had done ourselves in, by exporting too much of our technology of manufacturing to foreign competitors.

Times do change. The NMTBA's members closed the year by swapping ideas on how to sell abroad. To those optimists who believe that an interchange of ideas (even across the borders) usually results in a net gain for all participants, this is a good omen.

To those who fear we're losing our grip by letting the foreigners have our manufacturing methods, the proposal that we import ideas from abroad might seem a more realistic approach than the idea of cutting off such exports. After all, the worth of a good idea is only realized when it is made to work, and who can make them work better than the manufacturing engineers of America?

The Joint is Foiled

A case in point is the foil seam process for butt welding steel sheet. This technique was originated in Germany. Known as the Peco



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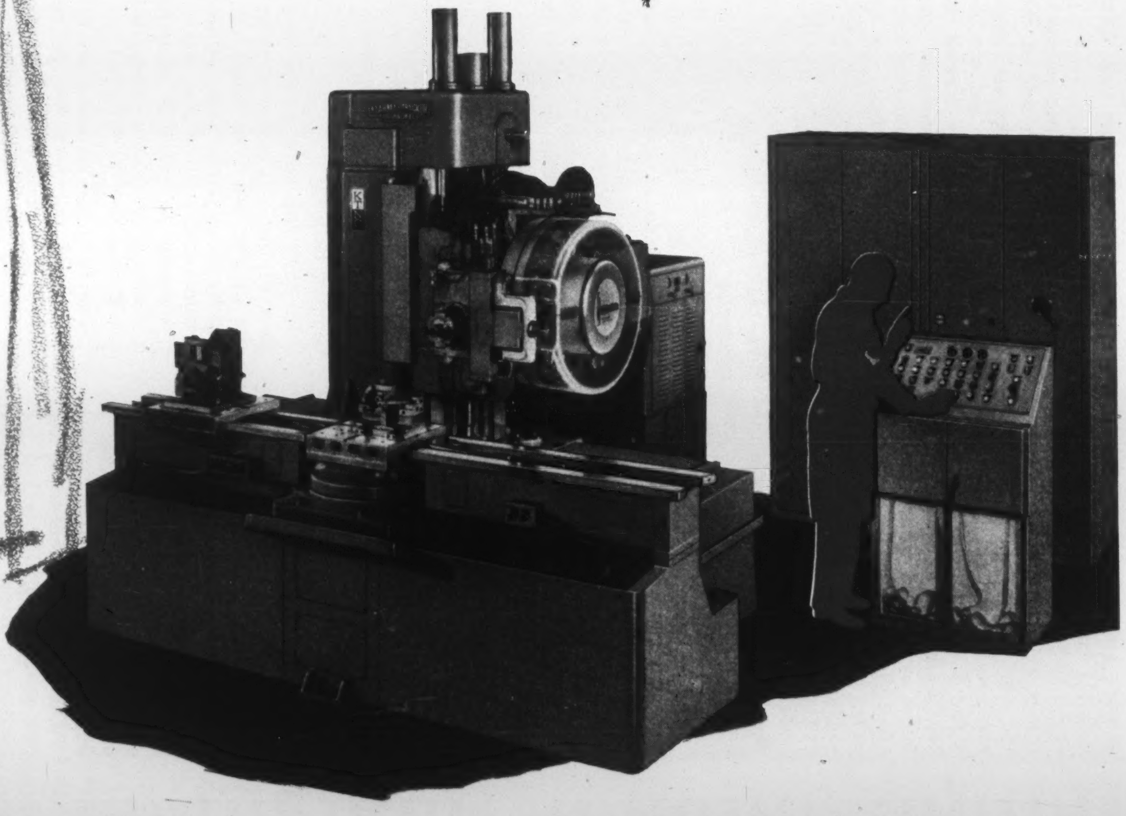

MILWAUKEE-MATIC with Automatic Tool Changer — Double-acting mechanism inserts new tool in machine spindle while returning used tool to rotary magazine in only 9 seconds. Magazine holds 30 tools (plus one in spindle).

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Process, it has been dubbed "foil welding" by the trade. To those who draw pictures from word descriptions this is a misnomer if they conclude that the process welds two pieces of foil. On the contrary the purpose is to butt weld two thicker pieces of steel with ribbons of thin steel (foil) applied to the joint during the weld, and thus produce a joint of high integrity.

The process can be likened to that of joining two pieces of cardboard by butting their edges and then applying adhesive tape to the joint, except the two cardboards are made whole in the process. The process has been in widespread use throughout Europe for several years. Recently, through a licensing agreement and U. S. Pat. No. 2,812,417 this process has been made available in the western hemisphere.

Details Described

L. W. Mecklenborg, development engineer with the Precision Welder and Flexopress Corp., described and reported data on this process in a paper presented in Detroit to the annual meeting of the American Welding Society.

The weldment is made by butting the edges of the parts to be joined and passing the joint between roller electrodes in the conventional manner except that thin narrow strips of steel are introduced above and below the joint as it enters the roller electrodes. The strips (or foil) are usually 1/8 to 5/32-inch wide by 0.010-inch thick.

Mecklenborg lists the primary functions of the foil as: 1. Concentrate weld current in the area of the joint. 2. Contain the plastic weld metal and prevent expulsion. 3. Serve as a bridge to distribute weld current evenly between the two sheets. 4. Prevent too rapid withdrawal of heat from the weld. 5. Give a slightly raised weld bead as opposed to excessive indentation experienced without foil. 6. Offer slight additional resistance at weld line, thus contributing to welding heat.

This process is of particular interest to automakers' stamping plants because it provides a method for making big pieces out of little ones.

Ford's Dearborn Stamping Plant personnel can see application potentials: Body stampings may be welded together along contour lines to produce complicated assemblies that could not be made in one piece. Parts requiring extra wide sheet steel may be stamped from blanks seam welded from narrower stock. Offal that would otherwise be scrapped can be salvaged by welding small sheets into stock big enough to make certain stampings.

Various improvements in the basic process as used abroad were necessary to make it attractive in Detroit. The most important of these was an increase in welding speed from the inches per minute range into the 20-feet per minute range. Precision Welder developed improved equipment and the plant's manufacturing engineering dept. set about putting the process to work in production.

This "baby" was designed to weld two pieces of offal, blanked into triangular shape, into a square that is used as raw material to make inner housings for fuel tank filler pipes.

The machine has two magnetic chuck tables on each side of the carriage rails. Blanks are hand loaded to each table and are accurately and securely located so that the required minimum gap is established and maintained even during the pressure build up in the weld cycle. As the cycle starts, the electrodes come in contact with the workpiece and the foil. The carriage moves electrode heads along the rails and the pieces are welded together. At the end of the stroke the electrodes lift away from the work, at which instant a relatively high voltage pulse of current is sent through the foils causing them to burn in two at the weldment. This leaves the ends of the foils in position at the electrodes for the next weld.

As the carriage retracts an automatic extractor, adapted to the equipment by Ford, moves in and magnetically picks up the weldment, brings it out of the work area and drops it on a stack.

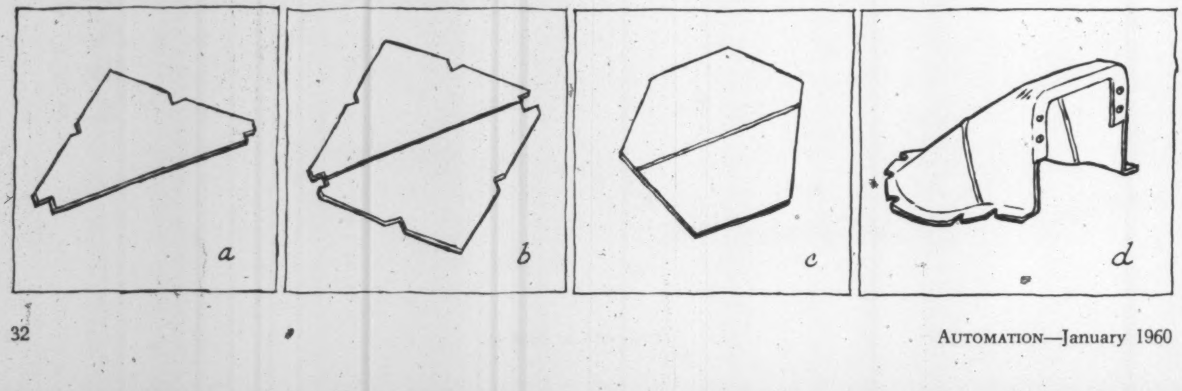
Glowing Returns

In analyzing costs it has been observed that a plant that generates its own offal can expect savings by using this process. Where a substantial part of the cost of a stamping is price of material it means a lot to use stock that would otherwise be scrapped.

The technical journalist on the beat could not help but be reminded of the meat packer who sells all of the pig except the squeal. This type of development is like bottling the squeal.

The whole concept of taking new techniques and working them into competitive, cost saving processes that automatically make for a better way of life gives us a rosy glow for 1960.

Ford's Dearborn Stamping Plant salvages offal by first preparing a triangular blank (**a**) notched to fit locators in the welding machine. Two blanks are foil seam welded (**b**) to provide stock large enough to be blanked into a shape (**c**) from which the inner housing (**d**) for the fuel tank filler pipe is produced by subsequent pressworking operations. Pull tests show weld to be stronger than parent metal.



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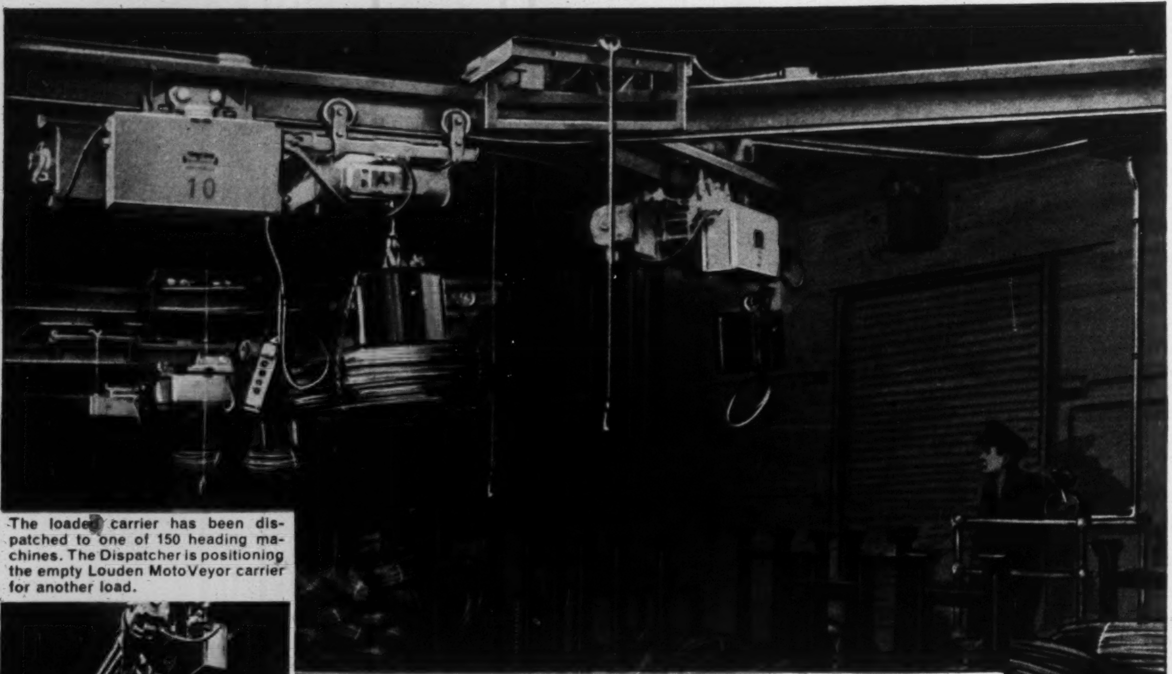
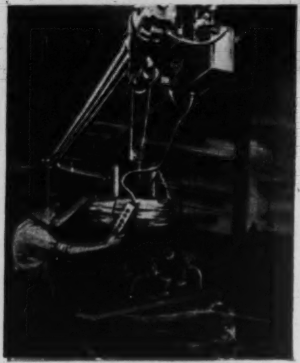
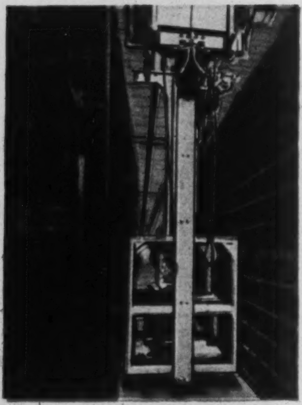


The loaded carrier has been dispatched to one of 150 heading machines. The Dispatcher is positioning the empty Louden MotoVeyor carrier for another load.



The carrier automatically stops at a selected heading machine, and operator lowers the coil of wire to heading machine reel. After hoist is raised, carrier automatically returns to Dispatch Area. Louden Shok-Pruf Electrification is used throughout.



Two Louden Tiering Trolleys serve each pan storage aisle. View shows Tiering Trolley Operator removing tote pan from storage for transfer to another department. The platform of the motor driven Tiering Trolley raises and lowers enabling the operator full coverage of the storage aisle. Current supplied by Shok-Pruf Electrification.

Industry's Airways UNTANGLE Materials Transport

In planning their new plant at Clifton, New Jersey, the Parker-Kalon Division of General American Transportation Company, manufacturers of self-tapping screws and metal specialties, "took to the air" to end longstanding problems and needless costs in materials handling. Working with Louden engineers, they took advantage of the opportunities offered by monorail overhead handling to coordinate materials supply and manufacturing needs from receiving of raw stock to the shipping of the finished product.

Typical of the improvements made was the handling of stock in the Heading Room. In previous practice, 450 pound rolls of wire were carried by fork truck, one roll at a time, and stacked at one end of the department. When any machine needed wire, the machine operator had to roll a bundle from the supply to the machine, lift it manually and place it on the empty reel. Now Louden equipment ends all this waste of time and the ever present chance of physical injury. Louden handling delivers the stock wherever needed easily, swiftly and safely.

When you have a materials handling problem or plant problem involving lifting and transporting loads, call on Louden for suggestions. Louden's unparalleled experience and proven engineering leadership combined with Louden's broad line of equipment can save time and mistakes. Write or wire today.

Get the latest information on the best in modern materials handling systems. Write today for your copy of "Economical Material Handling," a 52 page book full of how-to-do-it ideas. If you are interested in automation, ask for the new book on Louden Automatic Dispatch, "Automatic Materials Handling." With either you will receive the latest information on Louden Shok-Pruf Electrification, new safety in power for cranes and monorail systems.

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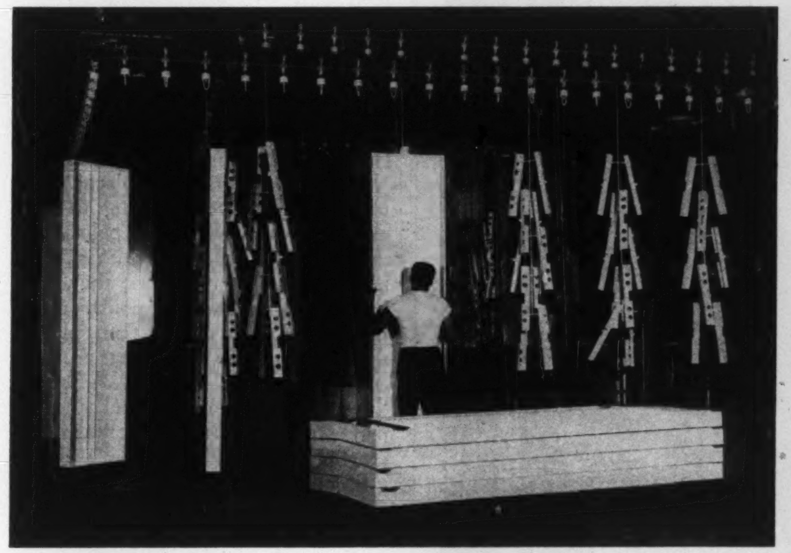
western trends

By PATT PATTERSON
Los Angeles, Calif.



Parts of fluorescent lighting fixtures are cleaned, electrostatically spray painted and baked on this automatic finishing system installed at Western Lighting Corp. Large parts are suspended from hooks and small parts are placed on carriers. The system requires operator attention only at the load and unload points and at a paint touch-up booth.

Automatic Finishing

MATERIALS HANDLING, particularly in the finishing field, is a natural area for automation. Where parts are heavy, bulky, or subject to damage by repeated manual handling, an automatic system is often used to move parts through the various finishing stages.

At Western Lighting Corp., Los Angeles, an automatic conveyorized metal finishing system is used to handle fluorescent lighting fixtures. The system was installed for three basic reasons: Production cost reduction, improved quality of finished product, and decreased lead times.

After sheet stock has been fabricated, the fixture parts are moved to the finishing area. Large parts are suspended from hooks on an overhead monorail conveyor. Smaller parts are placed on carrier racks to permit space savings.

Cleaning takes place in a 44-foot long enclosure where the parts undergo a three-stage chemical bath which primes the metal for painting. The first treatment in the bath consists of spraying a solution of either zinc or iron phosphate. This is followed by a warm water rinse. The parts then pass through an acid etch spray which prepares the surface for the paint.

The conveyor then moves the parts through a 24-foot drying oven. The parts are next cooled to ambient temperature during a 15-minute conveyor movement from the oven to a paint booth.

Painting is also an automatic process using an electrostatic system to cut overspray. The conveyor hooks contact a friction ring a few feet before entering the spray booth. Friction induced rotation of the hooks maintains a continual turning of parts to expose all sides to the spray.

The spray booth is circular, with the conveyor moving the parts through a 270 degree arc. The electrostatic sprayers are located in the center of the booth. The reciprocating disc spray mechanism rises and falls from the top of the parts to the bottom in a preset stroke pattern and spray setting. Because of the complex shapes of some parts, protected areas are often skipped by the spray. These are touched up in a succeeding 20-foot booth.

From the touch-up booth, the parts again pass through an open area to permit the volatile solvents in the paint to "flash-off" before the parts enter a 60-foot baking oven. The oven is a closed-end, two-pass type which maintains uniform temperature throughout the 20-minute travel. After cooling, parts are removed from the conveyor and stacked on pallets.

Furniture Finishing

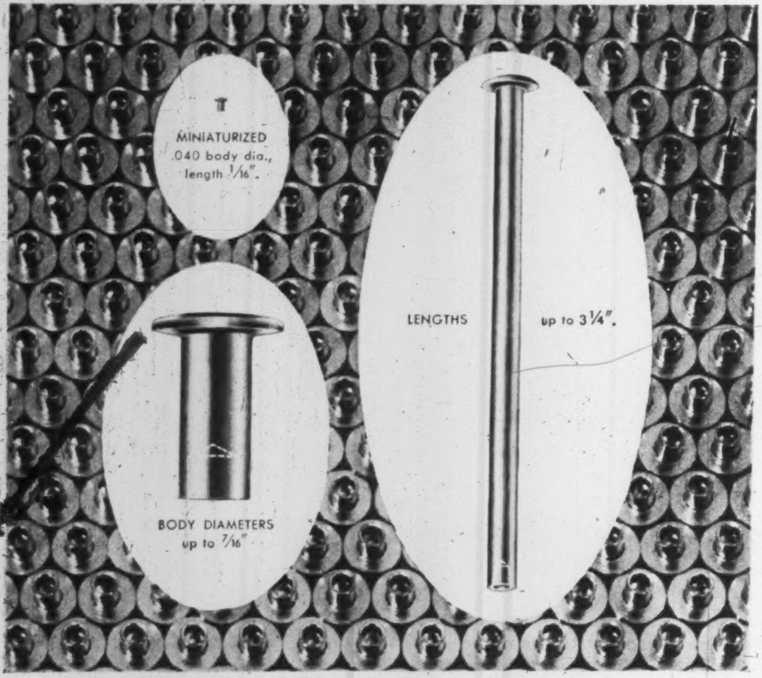
A similar type of automated line is used to finish furniture at the Los Angeles plant of Art Steel Co., manufacturers of metal office furniture.

The system finishes steel furniture varying from two-drawer filing cabinets to five drawer cabinets which measure over 57 inches high. The conveyor stations were planned to save space, and although the conveyor is 500 feet long, the entire finishing system occupies only 6000 sq ft of plant floor space.

The finishing phases include a three-stage washing cycle, a drying oven, spray booths, and a bake oven. The parts are manually loaded onto the conveyor after a preclean. They are then given a 5-minute bath in tanks of commercial chemical cleaner, plain water, and chromic acid at 180 F. From the final wash the units pass through a 26-foot drying oven in which they are exposed to 400 F for three minutes.

The spray booth has an air-re-

Look at this Size Range of Semi-Tubular Rivets...
it's the way to lower cost



Miniaturized components and also large complete assemblies can now have all the money-saving advantages of using single and multiple automatic riveting. This is due to the wider size range of semi-tubular rivets now available and which can be used in conjunction with motor and pneumatic driven automatic riveting machines.

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Chicago Rivet & MACHINE CO.
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Branch Factory: Tyrone, Pa.

Circle 674 on Page 19

placement system and water curtain to insure maximum finishing quality. The final finishing stage is a bake oven where the parts undergo a 15 minute baking cycle at 350 F.

After the baking, the parts are manually unloaded from the finishing system and assembled. The entire cycle takes less than one hour.

Plating Plumbing Fixtures

Conveyorized system is being used in the production of intricate and irregularly shaped plumbing fixtures at Harcraft Brass, a division of Harvey Aluminum, Torrance, Calif.

Incoming parts are placed in baskets on a conveyor leading to the machine operators in the polishing and buffing department. As the baskets pass the operators, they remove each container, polish and buff the contents, and then place the completed basket of parts on the conveyor.

This same conveyor takes the parts through an automatic washing machine, which removes all dirt, grit, and polish particles from the fixtures. The parts are air dryed upon leaving the final rinse and are moved to the racking area. Here, the baskets are removed from the conveyors, the parts inspected, and the baskets replaced on the conveyor to return for another load.

A "round-table" racking fixture is used to load parts onto plastic coated plating racks. These racks are placed on a transfer conveyor which carries them to the automatic plating machine constructed by Hanson-Van Winkle-Munning Co. After transfer to the plating machine, the racks are carried through the plating cycle, automatically immersing in the plating baths, brightening dips, and rinses for the proper length of time.

After air drying, the racks are transferred to a final overhead conveyor which carries them to an inspection station. Here the parts are removed, and the racks continue through a chrome strip and water rinse cycle which removes all clinging chrome plate. They then return to the racking area for reloading.

The use of automatic conveying for the multitude of small parts plated at the Harcraft plant has reduced costs by a large margin. The overhead conveyors operating between departments were built by Chainveyor Corp.

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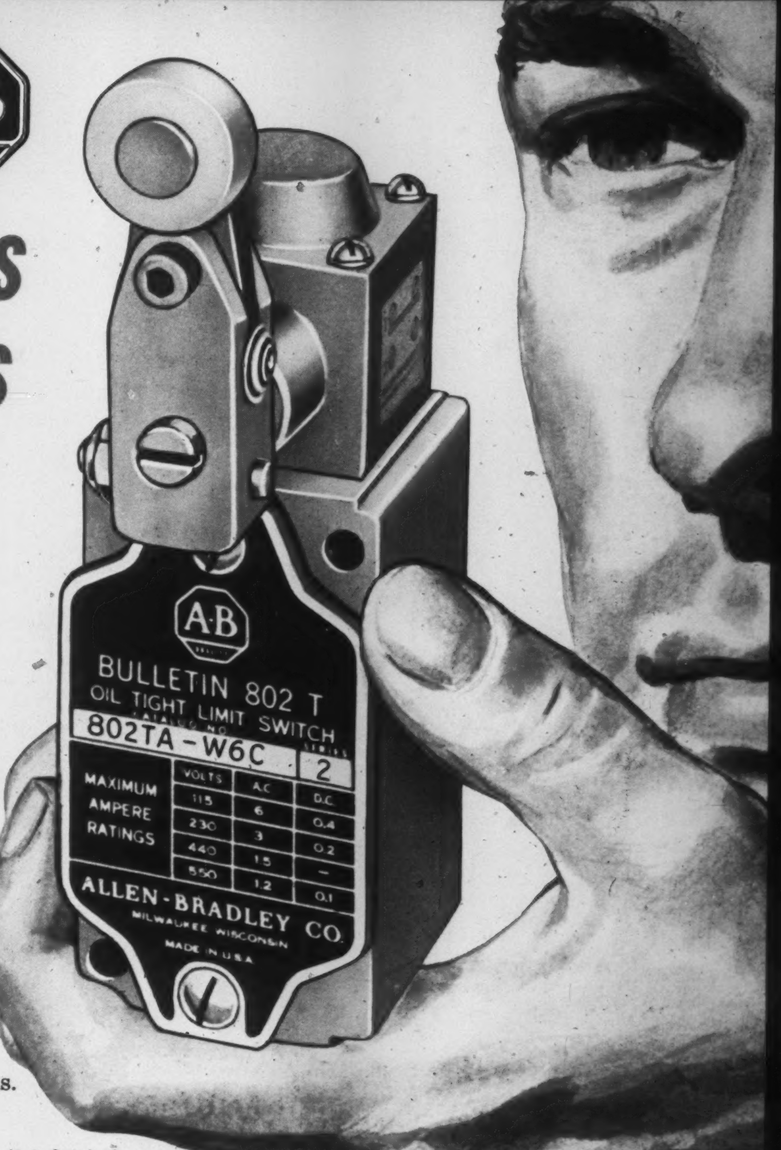
MORE MILLIONS OF OPERATIONS

with Allen-Bradley Limit Switches

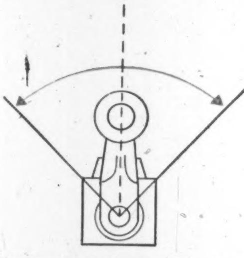
There's nothing now on the market to match the reliability and trouble free performance of Allen-Bradley Bulletin 802T limit switches. They are completely oiltight—operating heads and switch bodies are sealed against oils, coolants, and metal chips. Operators cannot become sluggish or "stick" in operation—contacts cannot become fouled. The double break, silver contacts are always in perfect operating condition—and remain so without maintenance.

Insist on Allen-Bradley—the *quality* line of limit switches that will give you *many more millions* of trouble free operations.

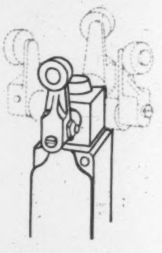

A-B
BULLETIN 802 T
OIL TIGHT LIMIT SWITCH
CATALOG NO.
802TA-W6C
SERIES
2
MAXIMUM AMPERE RATINGS
VOLTS
A.C.
D.C.
115
6
230
3
0.4
440
1.5
0.2
550
1.2
0.1
ALLEN-BRADLEY CO.
MILWAUKEE WISCONSIN
MADE IN U.S.A.

Bulletin 802T Micrometer Adjustment Roller Lever Limit Switch ▲

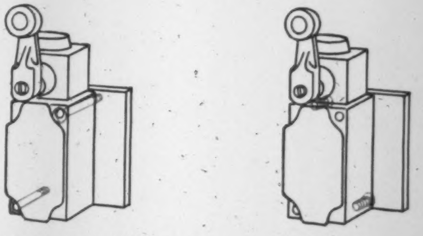
A-B Limit Switch features mean more life, more dependable trouble free service



REPETITIVE ACCURACY—Unique toggle blade action assures operation at precisely the same point each time, without adjustment.



FLEXIBILITY—All operating heads can be rotated and fastened in any of four positions 90° apart.



FRONT MOUNTING **REAR MOUNTING**

All Allen-Bradley Limit Switches can be mounted either from the front . . . or from the rear.

SEE OTHER SIDE FOR TYPICAL APPLICATIONS →

1-60-MR

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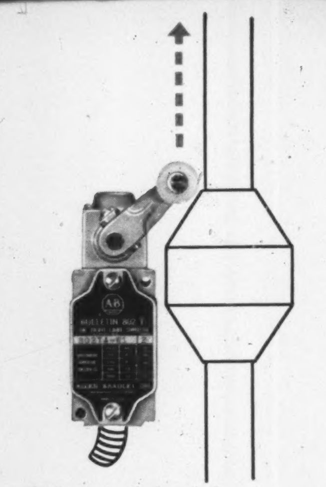
Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis. • In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

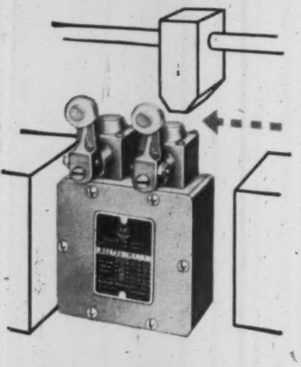
QUALITY MOTOR CONTROL

Allen-Bradley has an Oiltight Limit Switch to meet your exact needs!

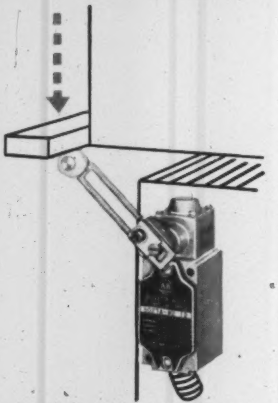
From among the wide variety of Allen-Bradley oiltight limit switches, you are certain to find the exact type to satisfy your specific requirements. If you do not, then please discuss *your* problem with us. A-B limit switches are available with many different levers, lever-contact actions, operating forces, and actuator motions—in spring return or maintained contact construction. A new 16-page illustrated booklet on this *quality* line of A-B oiltight limit switches is just off the press. Write for it!



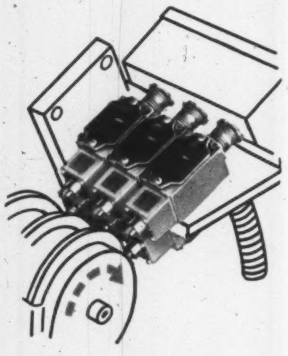
Roller lever limit switch— Here it is operated by dog on vertically moving shaft.



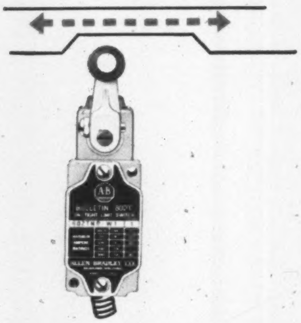
Duplex limit switch where block can also trip second switch for safety insurance.



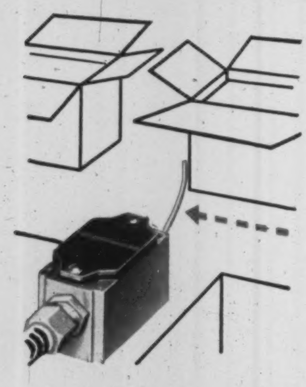
Adjustable roller lever switch. Lever set for operation at greater than normal distance.



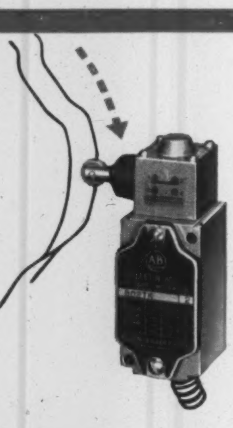
Top push roller limit switches are frequently operated by rotating cams on machine tools.



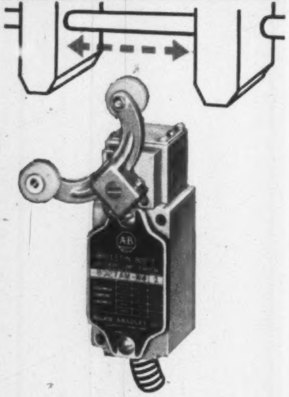
Neutral position switch— moving bar closes separate contacts as it moves each way.



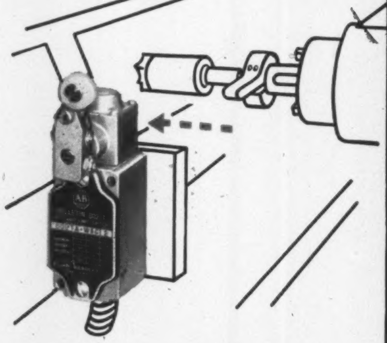
Cat's whisker limit switch is actuated by movement of lightweight units on conveyor.



Side roller limit switch, as illustrated here, is being actuated by a rotating cam.



Fork lever maintained contact switch—adjustable dogs trip one roller in each direction.



Micrometer adjustment switch for precise setting of trip point in machine tool operations.

1-60-MR

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AUTOMATION

Masters of Progress

As this new year of 1960 opens a new decade, we look on a multitude of challenges unprecedented in American history. Not the least among these is that facing management and labor: To begin to chart a fresh new course and lay the foundations for a golden age of progress and understanding in the years ahead.

In the competitive world of the sixties and beyond, only mutual respect and full co-operation between management and labor will enable America to remain prosperous and free and fulfill her role as a strong leader among nations.

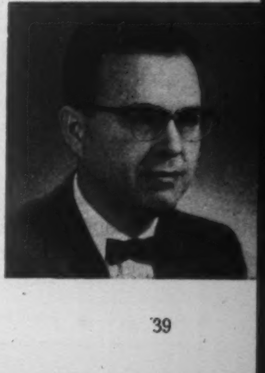
As we ponder the immense complexities and responsibilities looming on the horizon, a few thoughts voiced recently by James W. Oram, Pennsylvania Railroad vice president, take on particular significance when he says:

"In a free business system, jobs and economic expansion are created by profits—not by unions or politicians. Antiproductivity embodied in the 'spectator' working practices of standby or sitby jobs is the death of profits and the destroyer of jobs. Since Labor's essential objective is the creation of jobs which lead to higher pay, higher living standards, it should be the *enemy* of waste, not its protector. For jobs are never created by artificial insemination or preserved in the 'mummy wrappings' of obsolescence. When Labor attacks management for seeking productivity, efficiency, it becomes a fifth column against its own interests—its own worst enemy.

"The only future for free Labor lies in a prosperous, efficient, *confident* industry—which fairly divides the fruits of production among employees and stockholders — which reinvests a sensible share of its earnings in higher productivity — which gives the public the benefits of progress in better goods and services at prices people can afford to pay. That future is the only future for *free people*. We will not reach it by blindly resisting change. We must move toward tomorrow with the tools and methods of tomorrow if we are to be *masters* of progress, not its *captives*."

Without realistic, forthright and understanding effort, the automation age may reveal only fool's gold in the final assay!

EDITOR



AUTOMATION

ESTABLISHING AN AUTOMATED PLANT

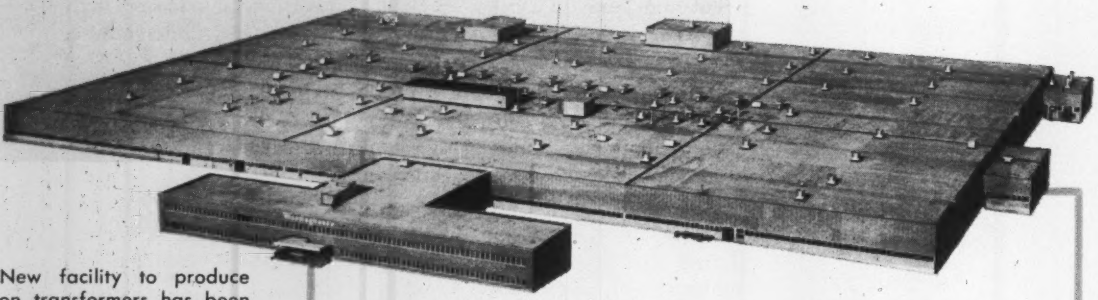


Fig. 1—New facility to produce distribution transformers has been placed in operation at Athens, Georgia, by Westinghouse Electric Corp. In 8 hours the plant produces approximately 250 units in models from 5 to 333 kva capacity.

Fundamental influence on costs in a production plant is the manufacturing engineering work done in establishing the operating facility. Policies and procedures for successful accomplishment of that work are readily illustrated by examples drawn from a new distribution transformer plant. The authors performed important roles in the establishment of that facility.

By C. G. NOLAN and T. J. MURRIN
Superintendent of Operations — Superintendent of Factory Planning
Distribution Transformer Plant, Westinghouse Electric Corp., Athens, Ga.

ENGINEERING a new production facility suggests careful planning for success whether it involves a completely manual process or a highly automated one. However, with a highly mechanized plant, the potential implications of failure are important enough to make proper planning mandatory.

Few manufacturing engineers would oppose these thoughts. The point of most practical importance to men with responsibilities in setting up a new facility hinges around methods to use in successfully planning and carrying out the project. Around this point there can be considerable area for question as to what methods will result in success in a given situation.

Undoubtedly, there will be more than one detailed method that might be used, but successful methods will generally include about the same basic considerations. In discussion of some of these considerations, experiences based on establishing Westinghouse's new $20 million distribution transformer plant, *Fig.* 1, provide good examples. For that particular project, a full-time planning organization was used. Methods which were successful there can also be applied with other types of planning assignments.

Establishing Objectives

When considering the opportunities of new plant expansion, management is attempting basically to optimize its marginal efficiency of capital; that is, to maximize the ratio of the expected net returns to the present cost of the new facility. Assuming that such a venture appears sufficiently attractive, top management's decision to build a new plant must be implemented by: 1. A clear and complete presentation of the primary objectives. 2. Setting the target date for plant startup along with completion dates on several major projects which can be used to schedule programs and check on progress. 3. The development of a planning organization and the procurement of its key personnel.

The immediate reasons for building a new plant—such as, increased capacity, closeness to new or expanding markets, reduced cost—will serve to indicate the most important primary objectives. For example, because Westinghouse management personnel foresaw the need for increased productive capacity to serve the South and Southeastern states, the primary objectives of the Athens plant included a specified production capacity (on a two-shift, five-day week basis), a required date on which to produce the first salable output, and a tentative schedule covering the increases in production up to capacity.

In setting such objectives, consideration must be given to the possibility that the particular product for which the new facility is being planned might become obsolete competitively. The period of time used in determining the potential return on investment data must be set accordingly. The determination of realistic objectives can minimize failures due, for example, to overly optimistic sales forecasting and the consequent providing of excessive manufacturing capacity.

The setting of a specific date for the production of the first salable unit will represent a compromise between the increasing advantages (and costs) of longer planning periods and the more immediate financial gains possible through earlier sales and better service. Relatively tight scheduling of an over-all project with concurrent—rather than successive—product design and manufacturing planning programs reduces the probabilities of error in sales forecasting and of the product becoming obsolete. Creative engineering personnel will strive toward additional improvements, and the determination of realistic target dates requires that they firm up and implement their development program—ideally where the "point of diminishing return" is reached.

In the procurement of major equipment, several stages take place—general analysis, preparation of equipment specifications, review of proposals and place order, design and build, test and ship, install, debug, initial operations. Working backward from the startup date—and allowing the necessary time to design and build the physical plant, along with the procurement, installation, and debugging of major items of manufacturing equipment—it will become obvious how much time is available for preliminary analysis and development work. *Fig.* 2 shows a typical schedule covering one of the Athens-Westinghouse manufacturing sections.

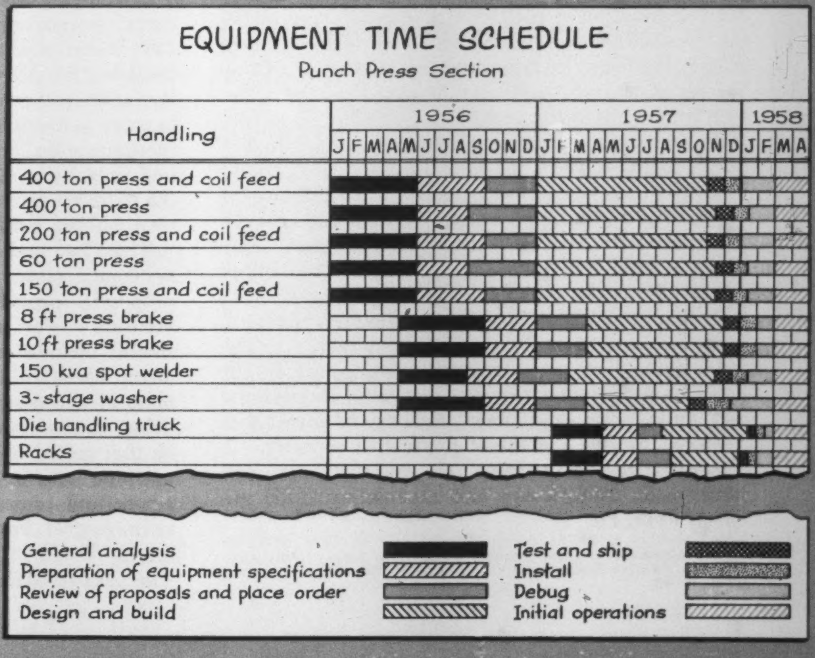


Fig. 2—Typical schedule illustrates chart method used to record planned progress in procuring and putting equipment into operation. Actual progress can be plotted on same chart to give quick visual indication of project standing. This schedule covers major manufacturing equipment required for the Punch Press Section.

ESTABLISHING AN AUTOMATED PLANT

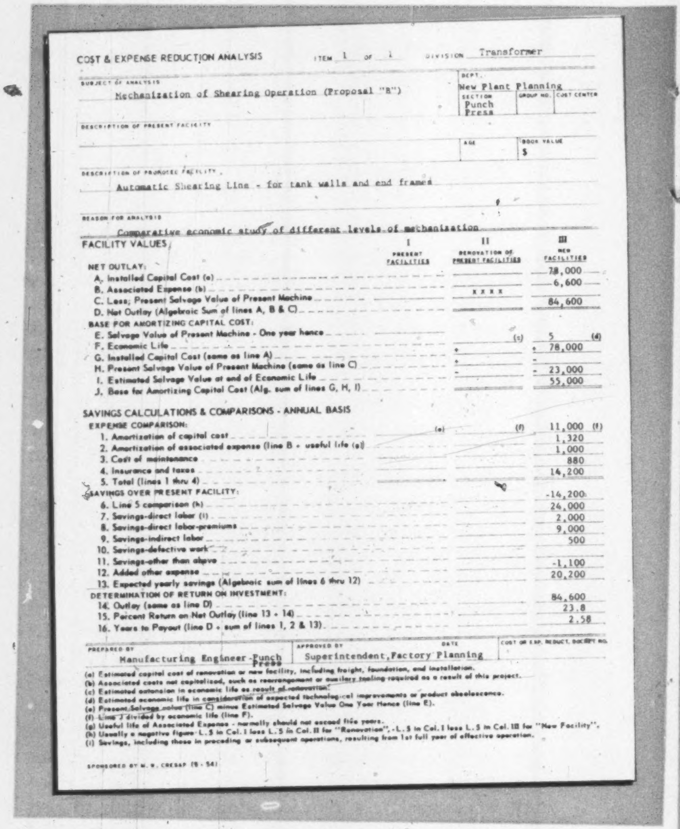
Supplementing the primary objectives for the new plant, there should be several specific secondary ground rules designed to guide the planning of the highly mechanized equipment. More than a dozen different objectives might be set in this regard. These can include improved quality, shorter lead time, reduced labor content, reduced inventory levels, lower overhead, scrap reduction, and safer operations. The relative importance of these objectives should be established, along with quantitative means of evaluation to set allowable levels of fallout, value of work-in-process inventory, etc.

Once the time schedule and primary and secondary objectives have been set, the magnitude of the challenges involved will become more apparent. These requirements can be translated into the size and type of planning organization that is required. The key personnel must be chosen, and decisions made on the functions and levels of supervision to be represented in the full-time planning organization, its interrelation with the parent organization, budgets for personnel, development programs, field trips, and the formulation of a steering committee to guide and evaluate the progress of the planning group.

▶ Studying the Economics

Regardless of what objectives are set up for the new plant, one of the necessary considerations is to maximize its profitmaking potential through more efficient manufacturing techniques. Industry in general uses several different means of analyzing the relative economic feasibilities of new machinery proposals, including: 1. Pay-off method. 2. Return-on-investment method. 3. Annual cost method. 4. Cash flow back method. 5. Machinery and Allied Products Institute method (MAPI)*. Consideration may or may not be given to taxes, depreciation, interest rates, and time value of money. The usually higher investments required for highly mechanized equipment, plus the continuing rapid technological improvements, put new significance on the accurate and complete accumulation and analysis of cost data. Highly mechanized equipment may have a productive life totally unrelated to either its tax life or its physical life.

In planning the Athens-Westinghouse equipment, two economic guides were used throughout: 1. The total equipment investment was determined on the basis of incremental per cent return on incremental net outlay over and above the lowest investment required to give the target productive capacity. 2. Quantitative comparisons of different proposals were made using a cost and expense reduction analysis form, *Fig.* 3.



COST & EXPENSE REDUCTION ANALYSIS ITEM 1 OF 1 DIVISION Transformer

SUBJECT OF ANALYSIS: Mechanization of Shearing Operation (Proposal "B")

DEPT.: New Plant Planning

SECTION: Punch Press

GROUP NO.:

COST CENTER:

DESCRIPTION OF PRESENT FACILITY:

AGE:

BOOK VALUE: $

DESCRIPTION OF PROPOSED FACILITY: Automatic Shearing Line - for tank walls and end frames

REASON FOR ANALYSIS: Comparative economic study of different levels of mechanization

FACILITY VALUES	I PRESENT FACILITIES	II RENOVATION OF PRESENT FACILITIES	III NEW FACILITIES
NET OUTLAY:			
A. Installed Capital Cost (a)			78,000
B. Associated Expense (b)			6,600
C. Less; Present Salvage Value of Present Machine		x x x x	
D. Net Outlay (Algebraic Sum of lines A, B & C)			84,600
BASE FOR AMORTIZING CAPITAL COST:			
E. Salvage Value of Present Machine - One year hence			
F. Economic Life		(c)	5 (d)
G. Installed Capital Cost (same as line A)		+	+ 78,000
H. Present Salvage Value of Present Machine (same as line C)		+	-
I. Estimated Salvage Value at end of Economic Life		-	- 23,000
J. Base for Amortizing Capital Cost (Alg. sum of lines G, H, I)			55,000
SAVINGS CALCULATIONS & COMPARISONS - ANNUAL BASIS			
EXPENSE COMPARISON:			
1. Amortization of capital cost	(e)	(f)	11,000 (f)
2. Amortization of associated expense (line B ÷ useful life (g))			1,320
3. Cost of maintenance			1,000
4. Insurance and taxes			880
5. Total (lines 1 thru 4)			14,200
SAVINGS OVER PRESENT FACILITY:			
6. Line 5 comparison (h)			-14,200
7. Savings-direct labor (i)			24,000
8. Savings-direct labor-premiums			2,000
9. Savings-indirect labor			9,000
10. Savings-defective work			500
11. Savings-other than above			
12. Added other expense			-1,100
13. Expected yearly savings (Algebraic sum of lines 6 thru 12)			20,200
DETERMINATION OF RETURN ON INVESTMENT:			
14. Outlay (same as line D)			84,600
15. Percent Return on Net Outlay (line 13 ÷ 14)			23.8
16. Years to Payout (line D ÷ sum of lines 1, 2 & 13)			2.58

PREPARED BY: Manufacturing Engineer-Punch Press

APPROVED BY: Superintendent, Factory Planning

DATE:

COST OR EXP. REDUCT. DOCKET NO.:

(a) Estimated capital cost of renovation or new facility, including freight, foundation, and installation.
(b) Associated costs not capitalized, such as rearrangement or auxiliary tooling required as a result of this project.
(c) Estimated extension in economic life as result of renovation.
(d) Estimated economic life in consideration of expected technological improvements or product obsolescence.
(e) Present Salvage value (line C) minus Estimated Salvage Value One Year Hence (line E).
(f) Line J divided by economic life (line F).
(g) Useful life of Associated Expense - normally should not exceed five years.
(h) Usually a negative figure L. 5 in Col. I less L. 5 in Col. II for "Renovation", - L. 5 in Col. I less L. 5 in Col. III for "New Facility".
(i) Savings, including those in preceding or subsequent operations, resulting from 1st full year of effective operation.

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Fig. 3—Sample of Cost and Expense Reduction Analysis form used to compare alternate equipment proposals. The form includes calculations to determine per cent return on net outlay and years to payout.

In applying the incremental return rule, the minimum investment—and related operating costs—were determined by studying job shop type manufacturing methods. The planners then progressively considered various stages of progressive-line manufacture, conveyorized-line techniques, advanced mechanization, and automation. Planning was limited only by available technological know-how and the requirement to meet a certain incremental return on the additional investments involved.

The Cost and Expense Analysis form presents a systematic means of evaluating alternate equipment proposals—provided the data used are complete and accurate. For example, Associated Expense, *B*, should include any auxiliary tooling required as a direct result of the new equipment, plus an estimate of the cost of labor and material required to debug the equipment. The Economic Life, *F*, should be that period of years until the time when the new machine will be economically replaceable with still newer and improved equipment, either because of technological improvements or because of changes in the design of parts produced by the equipment. The Cost of Maintenance, 3, should include indirect labor, parts, and occasionally outside services. It should recognize the possibility that additional maintenance personnel may be required to minimize downtime of highly mechanized equipment. Savings—Indirect Labor, 9, should show any anticipated change in expense personnel costs.

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*For discussion of these means see Robert A. Lowe, "Cost Analysis and Machine Replacement," AUTOMATION, Vol. 6, No. 8, August 1959, p. 46.

This method of analysis also tends to increase planned loading, capacity-wise, of the proposed equipment in order to maximize the per cent return on net outlay. Procurement of too much equipment is thus avoided. Other companies use different techniques such as that described recently by R. D. Seiler of International Business Machines Corp.*

In addition to making economic studies of the new manufacturing equipment, other aspects of the manufacturing system should be analyzed. For example, the cost of carrying different levels of work-in-process inventory should be determined and appropriate goals set. Much of industry values reductions in work-in-process inventory at about one-third of the inventory's direct material and direct labor value. For example, one equipment proposal might require $10,000 of work-in-process inventory while a second proposal might reduce this by 50 per cent because of increased flexibility or reduced cycle time. The economic analysis should recognize that a saving of about $1666 could be made ($1/3$ times $1/2$ times $10,000). This saving should be added to direct labor or other savings. Similar evaluations should be made considering cycle time, flexibility of output, quality control, and other influences.

Care must be taken in attempting to apply historically sound expense control ratios, such as direct-to-indirect-labor costs, hourly payroll to salary payroll costs, etc. Highly mechanized plants will tend to show relatively higher expense-to-productive labor costs, and only over-all expense analyses can give realistic evaluations. Careful attention must be given also to the breakeven volume—that level of production required to offset fixed costs and begin to produce a profit.

Comprehensive economic studies will indicate that certain costs are determined primarily by the product design, others mostly by manufacturing, and some by marketing requirements. Usually, the areas of present cost concentration will offer lucrative potential savings through product redesign and/or improved manufacturing techniques. Certainly, emphasis should be placed first on those product components or manufacturing operations that are most costly.

▶ The Physical Plant

Because of the money involved, the many technical decisions that must be made, the necessity for preparing a comprehensive specification for the building, and the time required to contract for and build a large modern plant, work should begin as soon as possible on the design of the physical plant. Ideally, the capacity requirements should be translated into plant space requirements (for receiving, fabricating, assembling, testing, packaging, storing, shipping, etc.) before the size and shape of the plant must be finalized. Knowledge of locally available power and services plus the requirements for the manufacturing equipment will permit determination of the required electricity, water, gas, and other services. Office requirements must be determined, layouts made and approved, and these plans incorporated into the over-all plant requirements. Decisions may be made about air conditioning, type of construction, quality of wall and floor finishings, etc.

Headquarters Works Engineering in Westinghouse is responsible for the co-ordination and technical know-how for all new major building constructions throughout the company. It is the responsibility of a division to forward plans to Headquarters regarding the size of the building, and the services required, and to co-ordinate with them to seek the optimum return on investment. In this regard, a division must accumulate data and decide on the shape of the building and its arrangement to best accommodate the material flow. A division must also co-ordinate any special considerations required

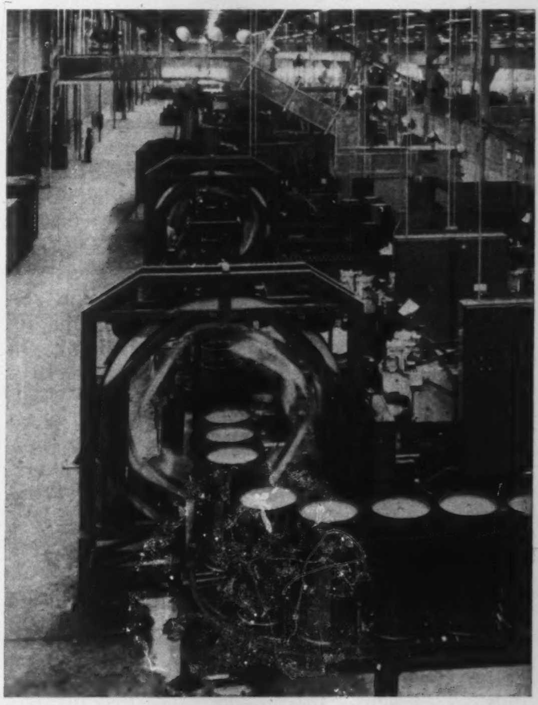

Fig. 4—One of the integrated production systems in the Athens plant is this line that produces the tanks in which the transformers are housed. Sheared blanks, cooling fins, brackets, and tank bottoms are brought to the line; completed tanks ready for painting come from the automated line.

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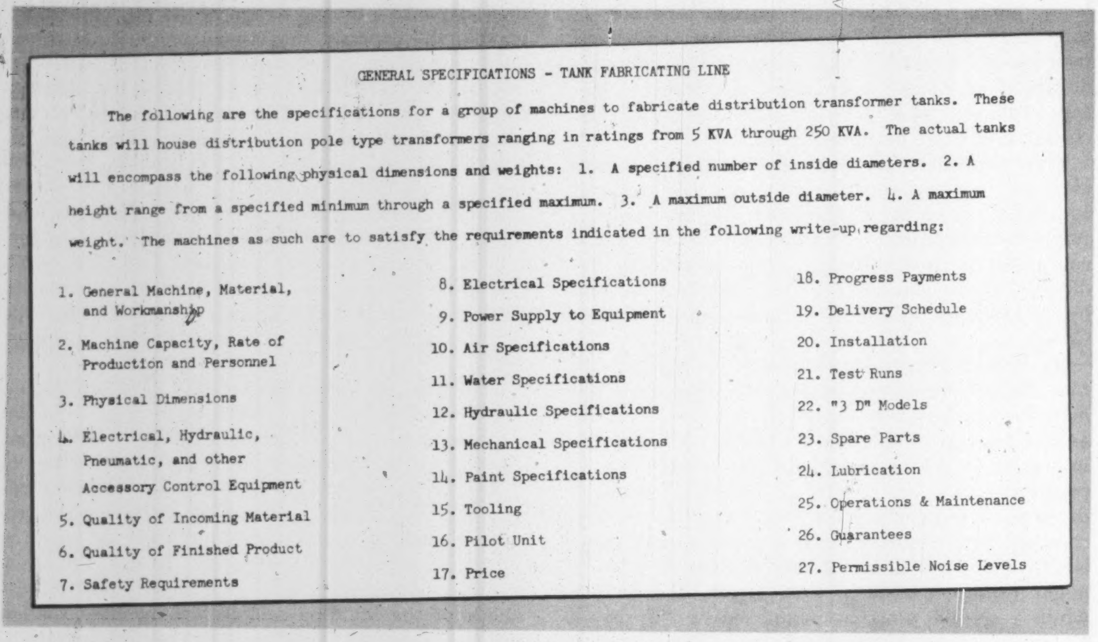
*Richard D. Seiler, "Developing Automation for Flexibility of Output—Economic Justification," Third Conference on Manufacturing Automation, Purdue University, March 23, 1959. See AUTOMATION, Vol. 6, No. 4, April 1959, p. 52.



GENERAL SPECIFICATIONS - TANK FABRICATING LINE

The following are the specifications for a group of machines to fabricate distribution transformer tanks. These tanks will house distribution pole type transformers ranging in ratings from 5 KVA through 250 KVA. The actual tanks will encompass the following physical dimensions and weights: 1. A specified number of inside diameters. 2. A height range from a specified minimum through a specified maximum. 3. A maximum outside diameter. 4. A maximum weight. The machines as such are to satisfy the requirements indicated in the following write-up regarding:

1. General Machine, Material, and Workmanship
2. Machine Capacity, Rate of Production and Personnel
3. Physical Dimensions
4. Electrical, Hydraulic, Pneumatic, and other Accessory Control Equipment
5. Quality of Incoming Material
6. Quality of Finished Product
7. Safety Requirements
8. Electrical Specifications
9. Power Supply to Equipment
10. Air Specifications
11. Water Specifications
12. Hydraulic Specifications
13. Mechanical Specifications
14. Paint Specifications
15. Tooling
16. Pilot Unit
17. Price
18. Progress Payments
19. Delivery Schedule
20. Installation
21. Test Runs
22. "3 D" Models
23. Spare Parts
24. Lubrication
25. Operations & Maintenance
26. Guarantees
27. Permissible Noise Levels

Fig. 5—Outline, based on general specifications for the line shown in *Fig. 4*, illustrates points to be covered for major pieces of equipment. Complete specifications give basis for sound competitive bidding by suppliers. They also give a comprehensive written record for planning personnel and management.

by processing, such as roof ovens, ventilating in special areas, or extraordinary loading of the floor or columns for equipment or special construction.

In the plant, uniformity in column spacing and roof heights will tend to reduce the lighting, power supply, and other service costs. A study by Westinghouse Headquarter's Works Engineering Dept. indicates that optimum costs can be approached by use of a 40-foot by 60-foot column spacing, and the Athens plant was designed on this basis. A study of the equipment to be installed, plus the anticipated conveyorization and material handling problems, determined the height of the building. In general, if a uniform height can be maintained, it is most desirable and will keep the factory space available for future rearrangements that might result from product redesign or manufacturing technique changes.

Interfunction Co-operation

J. R. Bright has noted* that advances toward automatic manufacture depend on five interdependent factors: 1. Highly mechanized equipment. 2. Factory layout. 3. Production processes. 4. Materials. 5. Design of the product. The first two factors are controlled primarily by manufacturing considerations, the third by manufacturing and product design, and the last two involve marketing as well as product design and manufacturing. Obviously then, to maximize the success of a new highly mechanized plant, close liaison must be effected and maintained by these three groups.

In planning the Athens plant, close liaison was required between the product designer responsible for distribution transformer tanks and the manufacturing engineer who planned the highly mechanized, $1 million tank fabricating line, *Fig.* 4.* Product design standardizations, made to take tank manufacture out of the job shop category, included: 1. The use of one gage of steel for tank walls and bottoms. 2. Reductions in the possible number of tank diameter-tank height combinations. 3. Reductions in the number of different lengths of cooling fins, with a maximum of two different lengths on any one tank. Fins are located at fixed intervals around the outside of the tank.

The new highly mechanized plant will help marketing through increased capacity and improved customer service, reduced product costs, improved quality, shorter lead time, and its sales promotional value. But, careful planning is required to prevent any troublesome inflexibility. Reasonably accurate forecasts of load and mix variations are required or manufacturing efficiencies will never be fully realized. Also, the probable variations in product design must be anticipated, for equipment of this type usually cannot be adapted readily to different designs. In general, an accurate and complete market analysis is one of the basic requirements for a successful highly mechanized plant.

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*James R. Bright—*Automation and Management*, Graduate School of Business Administration, Harvard University, Boston, 1958.

*See "Fabricating Transformer Tanks," AUTOMATION, Vol. 6, No. 7, July 1959, p. 53.

Individual planning problems within a department should be handled by the best qualified individuals. For example, relative to Accounting, get the over-all concept from the department head, but have any individual project followed by specialists—such as payroll from the Payroll Dept., budgeting from the Budgeting Dept., cost from the Cost Dept. Generally, this type of organization in a project gains the respect, co-operation, and enthusiasm of the entire organization and broadens all the personnel for the future.

▶ Specifying and Procuring Equipment

Regardless of who ultimately does the design, development, and building work on the production equipment, comprehensive machine specifications should be prepared on each major item. These specifications not only assure competitive bidding on an equitable, clearly defined basis, but are also invaluable in informing the planning personnel and management of exactly what is being planned. The specifications must include the usual information on capacity, productivity, description of product, quality requirements, safety features, maximum delivery time, and the like. The specifications for highly mechanized equipment should also clearly cover installation, test runs, guarantees, spare parts, lubrication, permissible noise level limits, preventive maintenance, and troubleshooting, etc.

The outline in *Fig.* 5 is typical of that recommended for major pieces of equipment. This sample is taken substantially from the actual specification used for the Athens-Westinghouse tank fabricating line.

To insure increased uniformity and completeness of future machine specifications, Athens-Westinghouse Factory Planning is developing a guide, from which the typical information in *Fig.* 6, covering electrical specifications, is drawn.

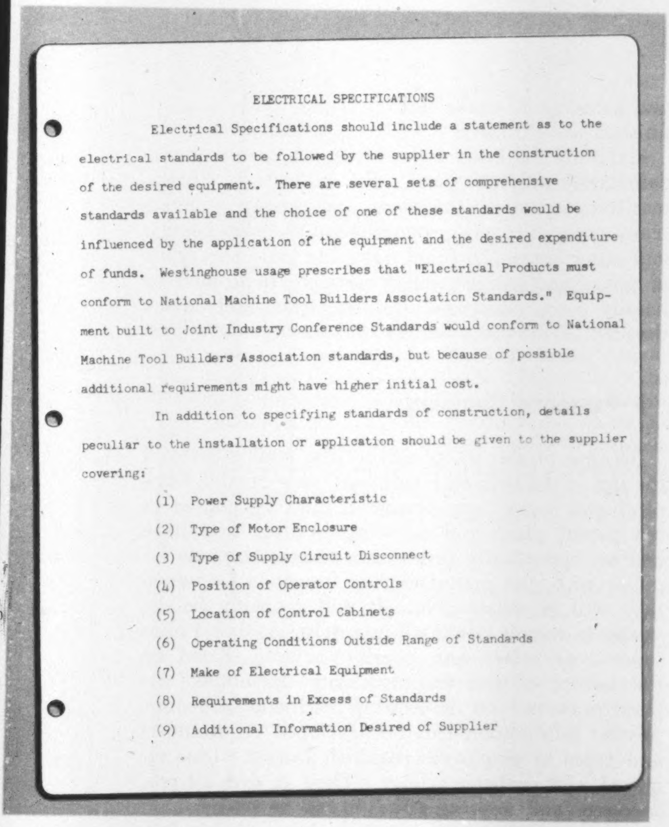
Once specified, highly mechanized equipment can be procured in many different ways. The planning group may consult venders to study the application and do the design, development, building, installation, and start-up work; or the planning group may have its own personnel to do all of this work. No one of these arrangements can be judged universally best, as evaluation for a particular situation depends on considerations of commercial secrecy, availability of capable personnel, time, money, experience, general business level, etc. If new plant planning is a relatively infrequent experience, the planning group probably does not have the personnel available to handle all phases of the procurement program. However, the planning group should work out the basic technical solutions to those problems which involve unique and novel applications of new designs, materials, or processes, and should always have its own personnel prepare comprehensive machine specifications.

Some vender reluctance to accept the more challenging and costly projects should be expected. Such projects often involve extensive, costly, and time-consuming engineering work. They may produce new equipment that the user may want to keep confidential and/or which will not be applicable to other customers. Also, by its nature, the development work is aggravating, and it is extremely difficult to accurately forecast the costs involved.

▶ Minimize Manual Handling

A careful cost analysis will probably indicate that a relatively high percentage of the manufacturing costs based on existing methods are due to nonproductive material handling operations. Also, it will become apparent that in order to minimize work-in-process inventory and cycle time, substantial improvements will have to be made in plant layout and material handling. One of the most effective tools in this regard is the development and use of a complete three-dimensional model representing all the manufacturing equipment and space involved.

Such a model permits nontechnical personnel to



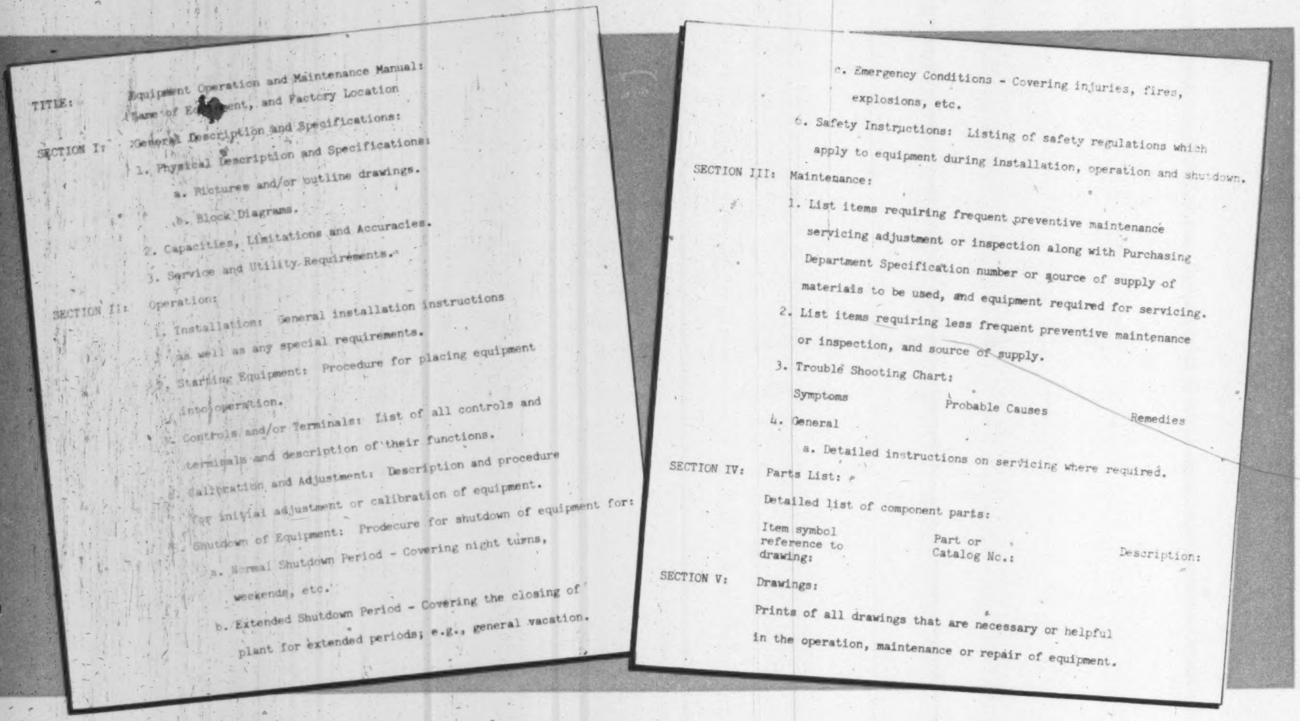
ELECTRICAL SPECIFICATIONS

Electrical Specifications should include a statement as to the electrical standards to be followed by the supplier in the construction of the desired equipment. There are several sets of comprehensive standards available and the choice of one of these standards would be influenced by the application of the equipment and the desired expenditure of funds. Westinghouse usage prescribes that "Electrical Products must conform to National Machine Tool Builders Association Standards." Equipment built to Joint Industry Conference Standards would conform to National Machine Tool Builders Association standards, but because of possible additional requirements might have higher initial cost.

In addition to specifying standards of construction, details peculiar to the installation or application should be given to the supplier covering:

(1) Power Supply Characteristic
(2) Type of Motor Enclosure
(3) Type of Supply Circuit Disconnect
(4) Position of Operator Controls
(5) Location of Control Cabinets
(6) Operating Conditions Outside Range of Standards
(7) Make of Electrical Equipment
(8) Requirements in Excess of Standards
(9) Additional Information Desired of Supplier

Fig. 6—Information from guide sheet on electrical specifications indicates means to increase uniformity and completeness of specifications for machines.



TITLE: Equipment Operation and Maintenance Manual:
Name of Equipment, and Factory Location

SECTION I: General Description and Specifications:
1. Physical Description and Specifications:
a. Pictures and/or outline drawings.
b. Block Diagrams.
2. Capacities, Limitations and Accuracies.
3. Service and Utility Requirements.

SECTION II: Operation:
1. Installation: General installation instructions as well as any special requirements.
2. Starting Equipment: Procedure for placing equipment into operation.
3. Controls and/or Terminals: List of all controls and terminals and description of their functions.
4. Calibration and Adjustment: Description and procedure for initial adjustment or calibration of equipment.
5. Shutdown of Equipment: Prodecure for shutdown of equipment for:
a. Normal Shutdown Period - Covering night turns, weekends, etc.
b. Extended Shutdown Period - Covering the closing of plant for extended periods; e.g., general vacation.
c. Emergency Conditions - Covering injuries, fires, explosions, etc.
6. Safety Instructions: Listing of safety regulations which apply to equipment during installation, operation and shutdown.

SECTION III: Maintenance:
1. List items requiring frequent preventive maintenance servicing adjustment or inspection along with Purchasing Department Specification number or source of supply of materials to be used, and equipment required for servicing.
2. List items requiring less frequent preventive maintenance or inspection, and source of supply.
3. Trouble Shooting Chart:

Symptoms	Probable Causes	Remedies

4. General
a. Detailed instructions on servicing where required.

SECTION IV: Parts List:
Detailed list of component parts:

Item symbol reference to drawing:	Part or Catalog No.:	Description:

SECTION V: Drawings:
Prints of all drawings that are necessary or helpful in the operation, maintenance or repair of equipment.

Fig. 7—Format for equipment operation and maintenance manuals is shown. Such manuals were prepared for all major pieces of equipment in the Athens plant. They are used to improve machine operation and facilitate maintenance.

make valuable recommendations to improve the layout of equipment and the mechanized flow of materials from operation to operation. Certainly, in terms of the relative cost of such a model to the total expenditure involved in a new plant, this represents a most attractive investment. A three-dimensional model results in improvements in material handling and the prevention of errors which would not have been as apparent if only two-dimensional models or conventional engineering drawings were used.

In planning the Athens plant, detailed review sessions to cover each manufacturing area were held around the model by the three levels of operating and staff personnel who would eventually staff the new plant. These review meetings served not only to optimize the physical layout before it was finalized, but also permitted each of the different functions to become familiar with their future participation in each manufacturing section and accelerated teamwork efforts in this regard.

One of the material handling challenges was due to the large number of design variations in the different sizes of product. Through co-operation with the product designers, many of the variables were standardized as were the processes for the major transformer components. Standardized manufacturing processes are now applied to dehydrating and curing all coils, to annealing all cores, to cleaning and painting all tanks, and to fitting and testing all finished transformers.

Handling facilities were developed to accommodate many different parts. For example, a Christmas-tree carrier on the paint line conveyor carries many types of covers, grounding straps, cover beams, and other items. In Final Assembly, only two types of power-and-free conveyor carriers are needed to handle cores, coils, end frames, tanks, and covers through all of the assembly and testing operations.

Personnel Training

Because of the complexity of the equipment and the size of the over-all investment, very capable technical and supervisory personnel must be chosen at the parent plant and transferred—after they have had an opportunity to plan, or at least become familiar with, the manufacturing functions for which they will be responsible. It will probably be desirable to recruit locally all nonprofessional and nonsupervisory salary and hourly workers. Based on the nature of the manufacturing operations, the plant capacity, and the existing production schedule, specific information can be developed on numbers and types of employees required, learning time required, and probable fallout. Then an over-all procurement and training schedule can be set up.

It is difficult to generalize in this area, but relative to an older plant in the same field, the new plant will probably require: 1. A higher proportion of trained skilled maintenance personnel. 2. A higher proportion of indirect labor personnel (as compared to direct labor personnel)—such as line loaders, setup men, and clerical people in functions such as production planning and control. 3. A higher proportion of engineers and technicians to plan, procure, and debug the equipment. 4. More effective techniques for the training of production operators.

Difficulty generally occurs in the procurement of electricians with the skill and training necessary to service electronic controls, and such individuals will probably have to be trained and developed on the job. Certainly the need for maintenance training programs in hydraulics and lubrication should also be anticipated. In highly mechanized plants, pneumatics, hydraulics, electronics, and mechanics are used in new combinations. During the debugging stage, it is essential to have skilled technicians or mechanics trained in the operation of these machines so that they can quickly detect the nature of the failure and make the necessary corrections. The ability to detect the cause of the failure in such machines will, to a great extent, determine the time required to debug the equipment and get the plant into profitable production.

Many benefits accrue from plant location in nonindustrialized areas—including a labor pool that is cooperative, hard working, and has good native ability. However, it must be recognized that certain skills are nonexistent in such areas and that the general work force has not had the opportunity for certain high school training that is normally available elsewhere (blueprint reading, mechanical drawing, shopwork, etc.). Definite difficulties will arise in obtaining capable experienced maintenance personnel, tool-and-die makers, technicians, and draftsmen; and training programs must be set up. In Athens, State-sponsored courses in blueprint reading are underway, taught by Westinghouse's supervisor of Tool Engineering and Manufacturing.

There are several generally accepted practices for training productive personnel, such as JIT (Job Instruction Training) and JMT (Job Method Training). Both methods were used extensively during World War II when a great mass of unskilled labor was required in industry for the war effort. Another step forward in this same type of training is the OIC (Operator Instruction Card), which includes all of the information in JIT and JMT, plus any pertinent information relative to ordering the part, tools required, machines required, drawings, process specifications and controls, etc. No longer does the operator have to go to several different sources of information.

An operator instruction card at Athens can vary in length from a single sheet to as many as forty or

THE AUTHORS

CLIFFORD G. NOLAN, superintendent of operations, distribution transformer plant, Westinghouse Electric Corp., is a veteran of 22 years with the company. His first supervisory position was as an assistant foreman in 1943. Other duties have included: Industrial methods engineer and manufacturing engineer for the ordnance department; coil winding foreman, power department, transformer division; responsibility of organizing, planning, and building an ordnance department; general foreman, transformer power department; and manager of factory planning, distribution transformer department.

Mr. Nolan was assigned the responsibility of the planning function of the Athens plant in 1955. At the conclusion of the planning function he moved to Athens as superintendent of operations. He is a graduate of courses at the University of Pittsburgh, Penn State, and the executive development program at the University of Georgia.

THOMAS J. MURRIN, when this article was written, was superintendent of factory planning, distribution transformer plant, Westinghouse Electric Corp. He has now been appointed European representative for the headquarters manufacturing department, reporting directly to Mr. D. C. Burnham, vice president of manufacturing.

Mr. Murrin joined Westinghouse in 1951 after receiving his degree in physics from Fordham University. He had assignments as materials engineer, transformer division, and supervisor of factory engineering, distribution transformer department, before his appointment as superintendent of factory planning for the Athens plant. He has taken graduate work at the University of Pittsburgh and the University of Georgia, and is coholder of several patents.

fifty pages, depending on the type of operation to be performed. The OIC is not only used for operator training but defines definitely the method to be followed, and is the basis for work measurement and capacity studies. It becomes a check not only on the operator, but also on the foreman's ability to get peak performance.

Operator effectiveness becomes as good as the stability of the method described and the foreman's control to see that the operator follows the instruction card. Quality problems can be traced through operator instruction cards and corrected in this manner. Effective control can be maintained by checking periodically on the more skilled operators for strict adherence to the instructions.

Experience in this plant has indicated that the longest training time requirement can be appreciably reduced through the use of this method. It has been found that after five or six weeks experience, operators no longer have to refer to the OIC—even when it is very lengthy.

Importance of Reliability

Careful consideration should be given to the impact of equipment downtime due to malfunction—particularly if a highly integrated line of many complicated, first-of-a-kind machines is involved. Some "negative brainstorming" can uncover many of the serious results of future equipment failures. With top management, ground rules must be determined on whether or not the risks involved will be taken on the equipment as proposed; or whether, for example, additional storage banks will be added, unique machines will be prototyped and life-tested, or the original objectives will be compromised so that more conventional equipment can be used.

In any case, potential downtime can be reduced and maintenance work facilitated by standardization of components, use of static control instead of relays, preplanning for ready access to vulnerable machine parts, adequate automatic lubrication, early instruction of maintenance personnel, etc.

In practice, calculations serve to indicate the extreme importance of high levels of reliability in integrated equipment, and as an over-all guide in estimating capacities. Actual situations are complicated by different levels of reliability in different machines, compensating storage banks that allow individual machines to continue running while other machines are being repaired or set up, variations in cycle times of different machines, and required stoppages to make setups for different style products, etc. Because of these considerations, the actual capacity will tend to decrease as the number and complexity of machines integrated together increase—all other factors held constant.

Perhaps some of the hardware and know-how being developed to answer the requirements of missiles will result eventually in much more reliable manufacturing equipment. To date, at least one major company has switched from vacuum tubes to a transistorized control system for a new large scale data processing system, with tremendous improvements in reliability.

One of the steps taken to improve machine operation and facilitate maintenance work at Athens-Westinghouse was the preparation of equipment operation and maintenance manuals for all major equipments. The format of these manuals is shown in *Fig.* 7.

In A Nutshell

When planning a new highly mechanized plant, primary consideration must be given to the economic, technical, and human factors involved. It is important to insure that the investment is sound and that the marginal efficiency of capital is optimized; to provide the advanced techniques to do the job better, faster, and for less money; and to recognize that the contributions of many people are demanded and that those people are a vital resource even after the new plant is operating successfully.

It must also be recognized that the success of such a new plant depends to a very large extent on the development and application of the best techniques of wage payment, line supervision, production planning and control, quality control, maintenance, methods determination, and operator instruction, etc. The use of three-dimensional scale models of all manufacturing equipment to optimize layout and work flow is recommended highly.

An automatic machine is not alone the substance of this improved mode of manufacture. Other primary factors include layout and material handling, product design, materials, and processes. Secondary requirements include an optimistic, farsighted management; accurate sales and marketing analyses and predictions; and vital contributions from other functions such as Purchasing, Industrial Relations, and Accounting.

Many of the gains in a new highly mechanized plant are of an intangible nature, and management can expect to capitalize on these. For example, "How much is the improved appearance and quality of every unit worth in 'Sales Value' and 'Reduction of Customer Service'?" "How much is automatic, uniform testing worth in the ability to better design products and reduce over-design?" These are some of the intangibles which could possibly be worth more than apparent savings.

Perhaps the most important single challenge in building a new plant concerns the ability of management to get the enthusiasm of all members of the organization behind the project. It is not very difficult to organize and appoint personnel to a task as such, but it is quite a challenge to lead, inspire, enthuse, and direct the personnel, and to gain the wholehearted support from all throughout the project.

CENTRALIZED COOLANT SYSTEM USES AUTOMATIC FILTER

AN IMPORTANT auxiliary function connected with transfer machining is the supplying of coolant to the multitude of cutting heads. Economy dictates that coolant must be reused. Ideally, reuse might provide for a constant recirculation of coolant in order to limit the total quantity in use. These considerations, then, create the problems of handling a fluid contaminated by chips and sludge, and filtering the fluid to prevent clogged lines within the system.

At the Sharonville plant in which automatic transmissions are manufactured, the Ford Motor Co. has established a centralized automatic filtering system capable of supplying 2000 gpm of coolant to transfer machines. In operation, contaminated coolant flows in gravity velocity trenches to a main settling tank; after a settling period, coolant is pumped to an automatic filter, where remaining contaminants are removed. From the filter, clean coolant is delivered to a reservoir that serves the transfer machines.

Supplied by Allis-Chalmers Mfg. Co., the pumps in the system were selected for durability and the ability to handle abrasive solids. About half the pumps are rated within a 500 to 800 gpm range and the balance in the 500 to 2500 gpm range. Two standard solids handling pump casing sizes met all system requirements.

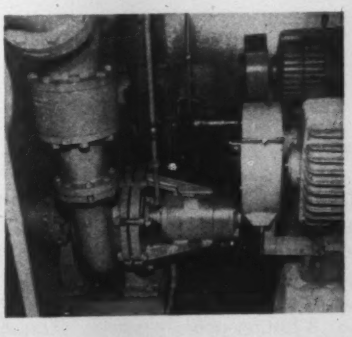
The different capacity requirements of individual parts of the system are met with only two impeller sizes. Different flow rates are obtained by varying pump speed through a V-belt drive and adjustable sheave system. The V-belt drive system also met minimum space requirements created by the pit locations of the pumps. In effect, each segment of the centralized system was provided with a customized installation by using only standard solids handling pumps, standard motors, and adjustable sheaves and V-belt drives.

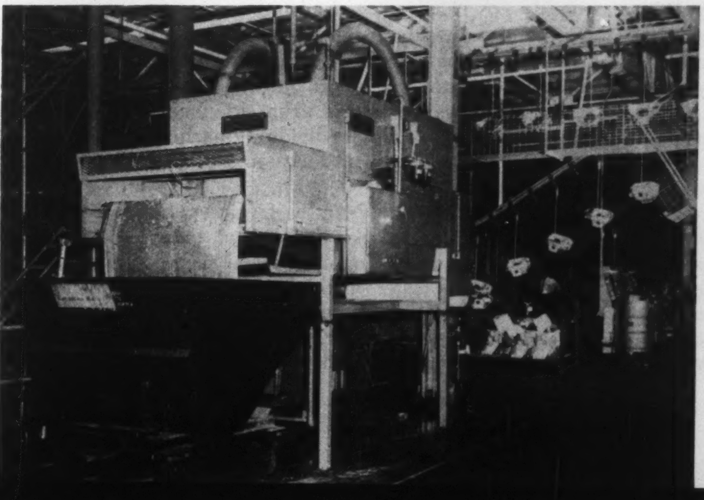
The filter in the system was manufactured by Hydromation Engineering Co. It is an automatic unit that incorporates two chambers between which is sandwiched a filter media. The filtering media used with aluminum chips is usually a type of cotton cloth, chosen for its wet-strength quality and ability to withstand the cutting and abrasive action of chips.

The filter cloth lies on top of an endless nylon mesh conveyor belt, which is supported on the underside by wide mesh screens and grating. With the two chambers clamped together, chip bearing coolant is pumped into the top chamber above the filter media. The coolant is forced through the media to the lower chamber; chips and sludge are retained on the filter cloth.

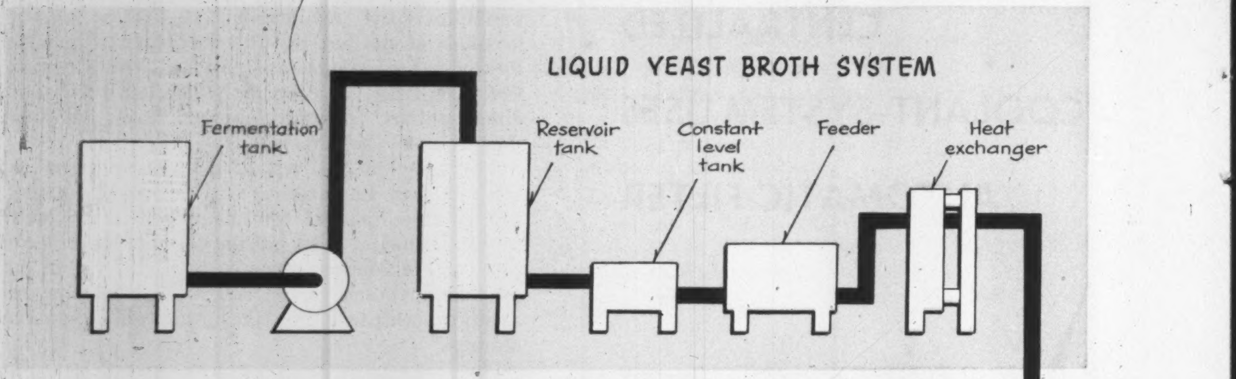
The equipment senses when the material build-up on the filter cloth reaches undesirable proportions, and coolant flow to the filter is interrupted. After a timed interval in which all coolant above the filter media is forced into the lower chamber, the upper chamber is raised by a pneumatic cylinder and the nylon conveyor indexes the length of the filter bed, removing the used filter media and sludge from between the two chambers.

The conveyor index that removes the spent filter media also moves a fresh length of cloth into position between the chambers. A limit switch actuated by the conveyor causes the pneumatic cylinder to lower the upper chamber, and a new filtering cycle is commenced.





Cloth filter media carrying entrapped sludge and chips is shown emerging from filter and dropping into waste hopper. The automatic cycling filter handles 2000 gpm of coolant in Ford Motor Co. plant in which aluminum automatic transmission cases are machined. A number of solids handling pumps (a typical installation is shown above) are used in the system. The pumps feature an oil-lubricated bearing bracket; bearing wear can be compensated for by an external adjustment. The design of the pumps permit them to be dismantled without disturbing the piping.



1 Time-saving method of fermenting a yeast broth rather than a dough mixture has cut dough processing time to about three minutes in equipment developed by Baker Process Co., Div., Wallace & Tiernan Inc. Liquid yeast broth, flour, oxidizing solution, and melted shortening are fed continuously at predetermined rates into a premixer. Ingredients are thoroughly mixed, and the resultant dough is metered into a developer for kneading, dividing, and panning. Dough pieces of predetermined weight and size are dropped at selected and automatically controlled rates into pans which are carried through proofing and baking. Output of the dough making equipment is variable from 2700 to 5200 pounds per hour.

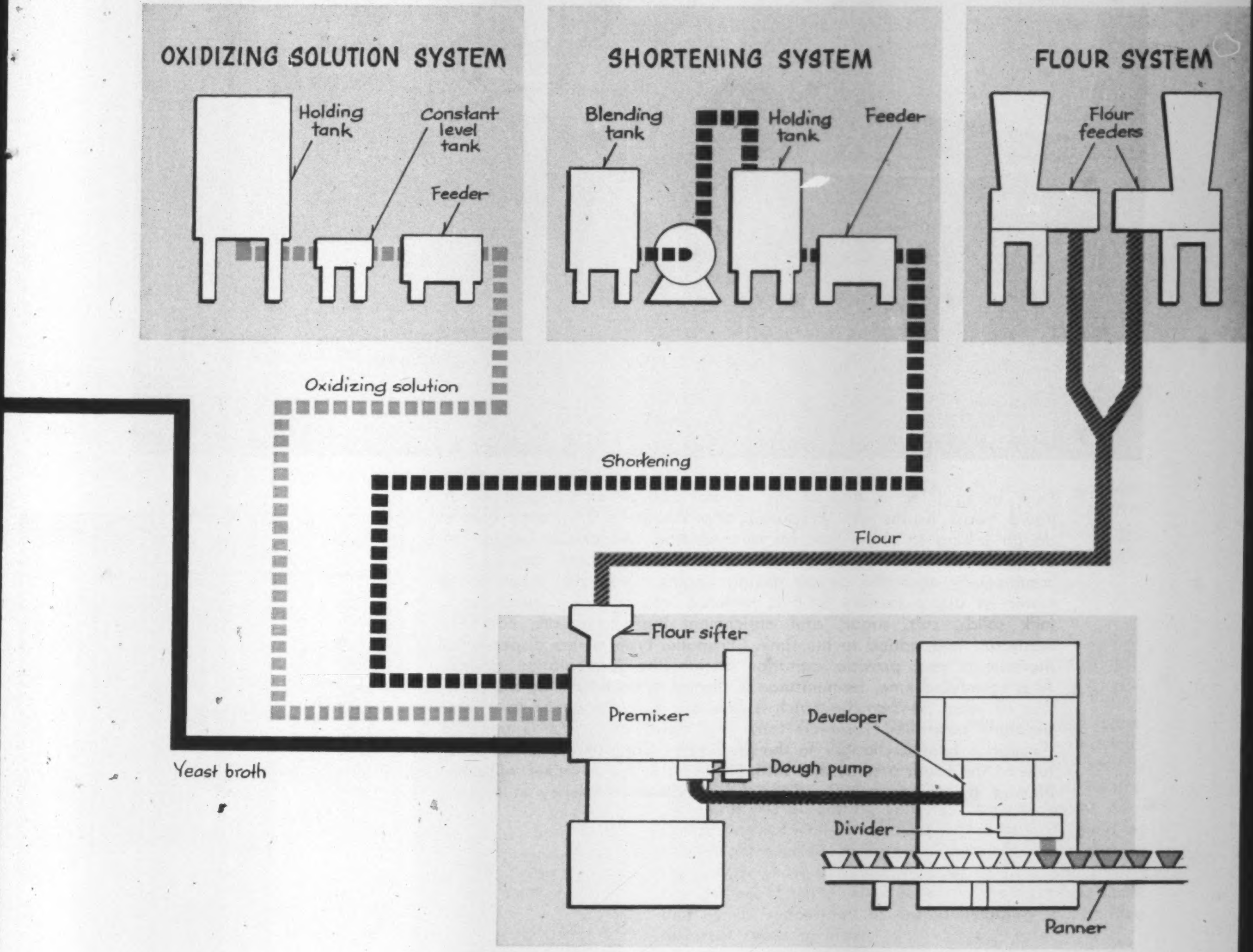
AUTOMATION TODAY

MIXING BREAD DOUGH CONTINUOUSLY

PRODUCTION of bread for the dinner table is a big business. At the present time the American people are consuming approximately 15 billion pounds of bread each year, and by 1970 the consumption of this food staple is expected to increase to 18 billion pounds yearly. Therefore, it is only natural that bakeries across the country have turned to automation as a means of increasing their productivity to cope with the increasing demand for bread.

Over the years automatic proof boxes, ovens, depanners, slicers, and wrappers have been developed and integrated into bakery production lines to a point where baking and handling efficiency has outstripped the efficiency of dough mixing. Although many phases of dough mixing have been mechanized, an automatic production line has not been practical due to the necessity of allowing the dough mixture to ferment or rise for several hours before dividing into individual loaves. In the conventional fermentation process, dough mixtures weighing up to 1200 pounds are prepared and placed in special rooms. During the development of the yeast, the dough is punched or kneaded several times to release some of the gas generated by the growing yeast plant. When fermentation is completed, the dough mixture is transferred to automatic dividing machines which cut out uniform pieces of dough and drop them into baking pans.

Realizing that the lengthy fermentation process was the stumbling block to automated bread production, Baker Process Co., Div., Wallace & Tiernan Inc., sought a faster method of fermenting bread dough. After years of experimentation, the company developed a process in which the yeast is fermented in a broth before it is added to the dough mixture.

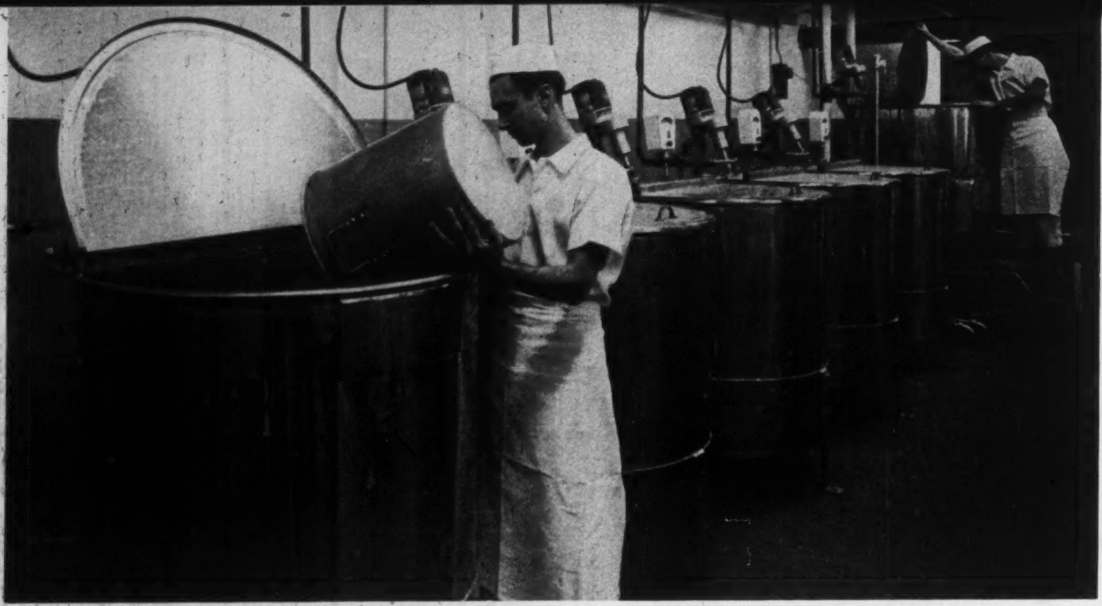


OXIDIZING SOLUTION SYSTEM
Holding tank
Constant level tank
Feeder
SHORTENING SYSTEM
Blending tank
Holding tank
Feeder
FLOUR SYSTEM
Flour feeders
Oxidizing solution
Shortening
Flour
Flour sifter
Premixer
Developer
Dough pump
Yeast broth
Divider
Panner

This process eliminates the time-consuming dough fermentation period and reduces the dough processing time from several hours to three minutes. In addition to making possible a continuous bread production line—from incoming raw materials to outgoing delivery trucks—the equipment for the process occupies only 25 to 40 per cent of the floor space that normally would be required for conventional equipment of the same capacity.

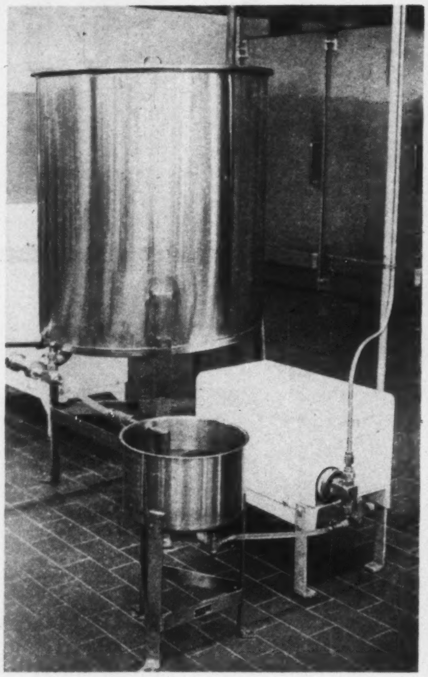
The automatic dough making process is illustrated in the accompanying photographs of an installation at Waldensian Bakeries Inc., Valdese, N. C. Sifted flour and batch mixtures of liquid yeast broth, oxidizing solution, and melted shortening are fed continuously at predetermined rates into a premixer. Here, ingredients are thoroughly mixed, and the resultant dough is metered into a developer for kneading, dividing, and panning. One advantage of the process is that only about 200 pounds of dough are in process at any one time. This amount can be removed from the system, refrigerated, and fed back into the process when production resumes. The automatic system can produce up to 87 one-pound loaves of bread per minute, and it can be changed in 30 seconds to make a different size of loaf with the minimum interruption. Two men can operate the entire dough making process.

The pumps and feeders in the four ingredient supply systems—yeast broth, oxidizing solution, shortening, and flour—are driven by infinitely variable speed drives having two-speed electric motors. Feed rates of the various systems are set at a central control panel by means of an indicator meter and a *Decrease-Hold-Increase* switch for each ingredient. When the switch is set to *Decrease*, the Link-Belt Co. variable speed drive is automatically



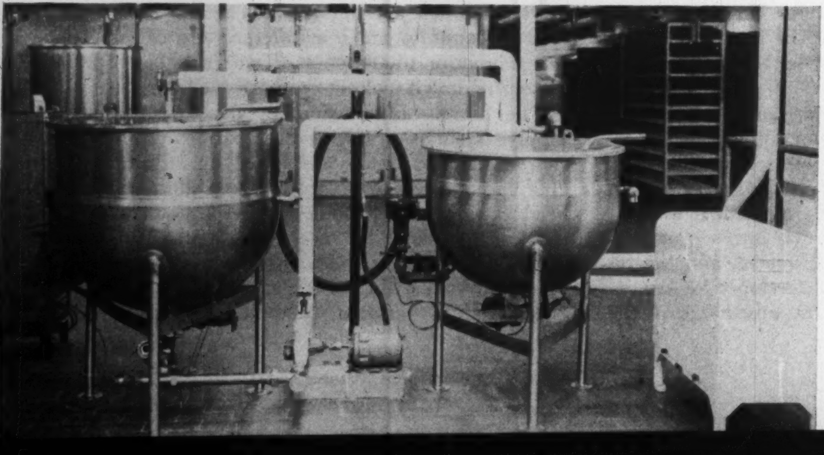
2

Tank being filled is one of the several 150-gallon tanks in which liquid yeast broths are prepared approximately 2½ hours before dough mixing to allow time for fermentation. Successive broths are prepared at about ½-hour intervals so that the broth can be fed continuously once the dough mixing begins. In broth preparation, water at approximately 84 F is metered into a tank. Yeast food, milk solids, salt, sugar, and enrichment ingredients are carefully measured and added to the tank. Propeller-type mixers disperse the ingredients and provide agitation during the fermentation period. At a scheduled time, fermentation is started in each tank by the addition of yeast. When the batch is finished, it is transferred to a temperature controlled reservoir tank (far right) and then is metered through a heat exchanger to the premixer. Controlling the temperature of the broth assures that all ingredients in the premixer will combine at the temperature selected for maximum efficiency in mixing.



3

A full day's supply of oxidizing solution is prepared in the large 100-gallon holding tank with potassium bromate, potassium iodate, and water. A 2-speed feeder meters the solution from the small constant level tank (foreground) to the premixer which is weight sensitive. When the premixer is full, it tilts downward, actuating an electrical circuit which changes the oxidizing solution feeder speed to give a 2/3 delivery rate. As the load in the premixer lightens, the unit tilts upward and switches the feeder back to full rate delivery.



4

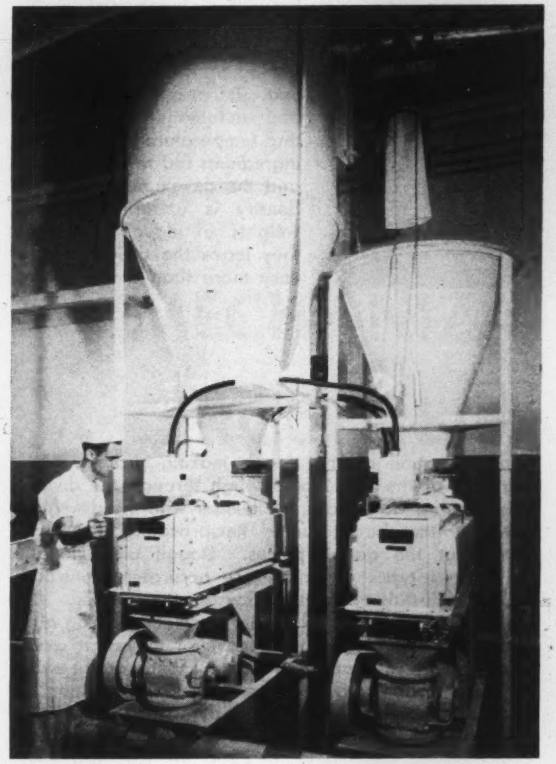
Lard or vegetable shortening, softeners, and miscellaneous ingredients are melted and blended in the tank on the left and then are pumped to the temperature controlled holding tank on the right. Liquid shortening is then metered into the premixer by a 2-speed feeder in a manner similar to that for the oxidizing solution.

varied until the desired reduced feed rate is indicated on the meter. The switch is then changed back to the *Hold* position, and the system automatically maintains the selected feed rate. Feed rates can be increased in a similar manner by setting the switch to *Increase* until the flow picks up to the proper point and then switching back to *Hold*.

The two-speed motors on the pump and feeder drives are a safety measure to keep the premixer from overloading. When the premixer is full, it tilts downward and actuates an electrical circuit which switches all of the drive motors to 2/3 speed. This action reduces the input of yeast broth, oxidizing agent, shortening, and flour into the premixer. When the dough load has dropped sufficiently, the premixer tilts upward and switches all ingredient feeders back to full speed. By continuously varying between full and reduced load, the premixer automatically maintains the proper flow of uniform density dough to the dough pump.

The dough pump is controlled from the central control panel. With this arrangement, production rates for the whole process can be controlled by varying the rate at which the dough pump supplies the developer. The operator can control the developer speed to take care of variations in flour strength. A recording wattmeter on the panel shows how much power the developer motor is using, and this enables the operator to determine the condition of the dough and any need for adjustment.

After the dough is panned, operations are the same as with dough mixed by conventional methods. The pans are conveyed to proofing boxes and tray ovens. After baking, the loaf is automatically depanned, sliced, and wrapped for shipment.



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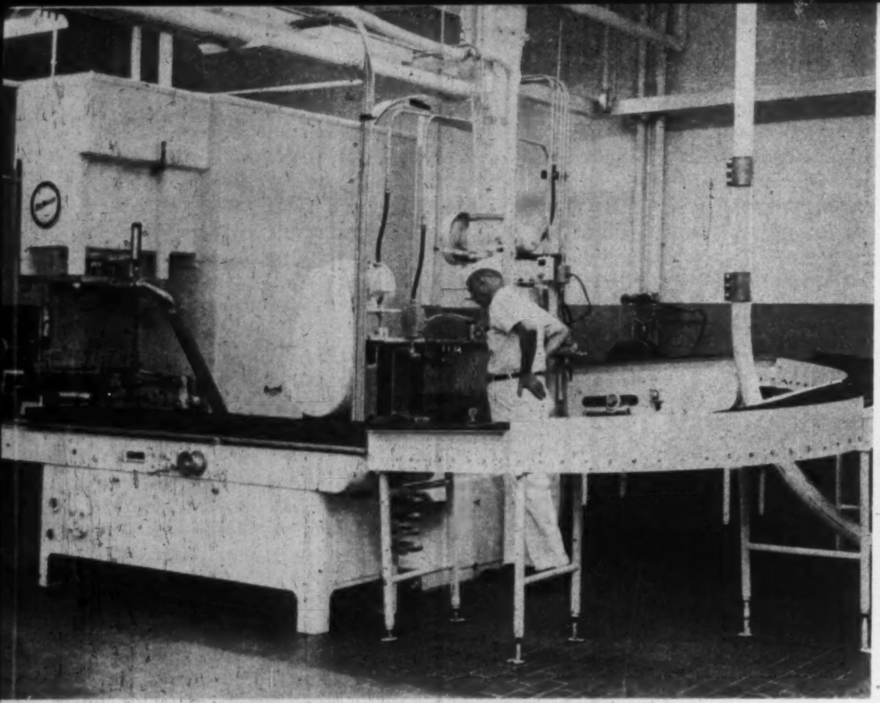
Flour is conveyed from storage bins into the cone-shaped hopper on the left which supplies an electrically driven gravimetric feeder. Flour delivery rate is remotely selected and indicated at a central control panel for the processing system. The gravimetric flour feeder is electrically controlled at full or 2/3 speed by the weight sensitive premixer. Automatic totalizers at the feeder show the total amount of flour fed during any period of time. The feeder on the right is a spare unit which is provided to permit flexibility in handling different types of flour.

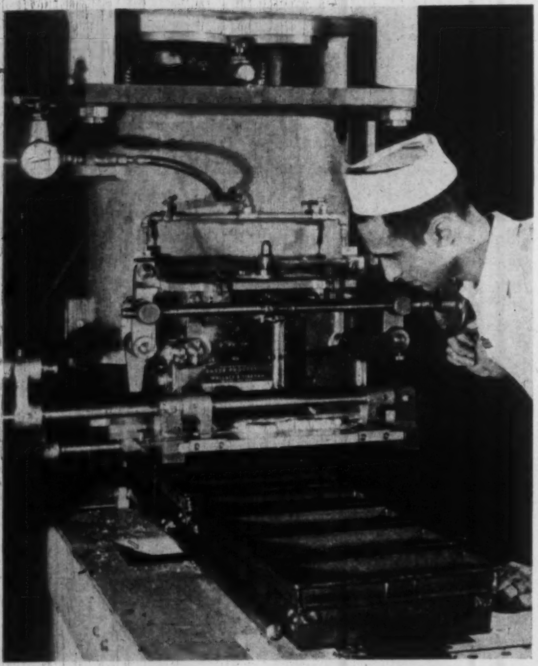
6

Fermented yeast broth, oxidizing solution, melted shortening, and sifted flour are metered continuously into the premixer at rates predetermined by the bakery's formula. Once the rates are set on the central control panel, the flow of ingredients is automatically maintained. Thorough mixing gives optimum dispersion of the ingredients in the flour. The viscosity of the dough in the premixer is measured by means of the premixer motor amperage and is indicated and recorded on a strip-type chart at the central control panel. Any variations in the ratios between the various ingredients which affect the dough viscosity are thus immediately evident, permitting prompt corrective action.



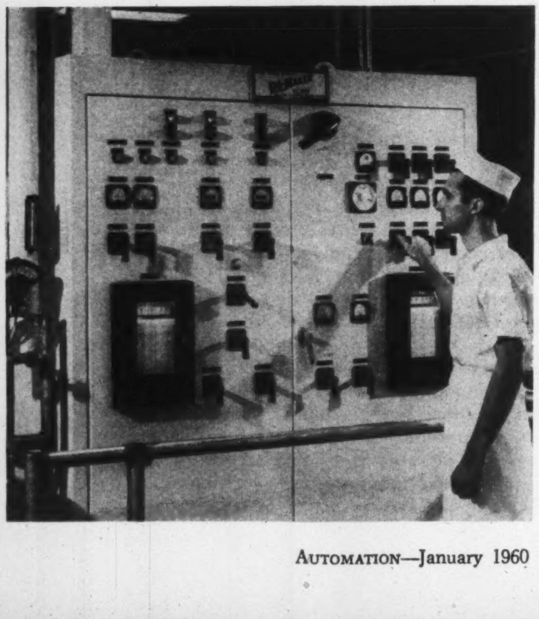
7

After mixing, the dough is pumped from the premixer (where operator is standing) through a pipe to the developer unit at the left. Dough is worked to proper condition in the developer by means of two variable-speed, counter-rotating impellers. From the developer the dough passes through a divider which accurately cuts the dough into pieces and drops them into baking pans on the conveying unit. Because of the accurate and automatic rate, weight, and temperature control of the ingredients fed to the premixer and the developer, the dough density is uniform, and the weights of dough pieces as they leave the divider do not vary more than a few grams.



8

Final operation of the dough making process is the extrusion of the developed dough through the divider. This close-up view shows the divider with the developer bowl in the background. Reciprocating horizontal knives cut the dough pieces. Dough piece lengths for various types of bread are accurately controlled by an adjustable outlet orifice at the divider. The pieces drop into pans which are positioned by an automatic panner. The panner conveyor moves at a uniform rate which is adjustable by a speed control switch at the central control panel. Movement of pans beneath the divider is controlled by the action of stop fingers which are actuated in synchronization with the cutoff knives.



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The dough-making process is controlled from this central control panel. Meters on the panel show how much of each ingredient is being fed so that adjustments can be made quickly.

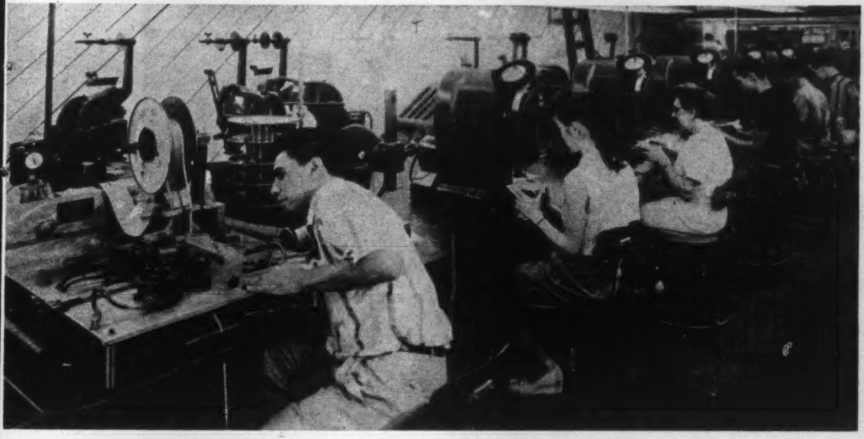

Fig. 1—Line of machines at right is used to assemble eyelets in predrilled, printed wiring boards. Machine at left automatically cuts and preforms leads of electronic components whose characteristics make it necessary to manually assemble them to boards.

MECHANIZATION SPEEDS CIRCUIT BOARD ASSEMBLY

WHEN DEMAND for its digital computers and other electronic products increased, Librascope Inc. was faced with a possible bottleneck condition in one of its manufacturing areas. Specifically, something had to be done to increase the production rate of circuit board assemblies. These units are the basic building blocks from which complex electronic devices are made up, and when requirements for the end products increased, many more circuit board assemblies were needed than could be produced economically by conventional manual methods.

To improve output, the company recently completed a development program aimed at introducing automatic and semiautomatic techniques wherever possible in the assembly process. Results of this

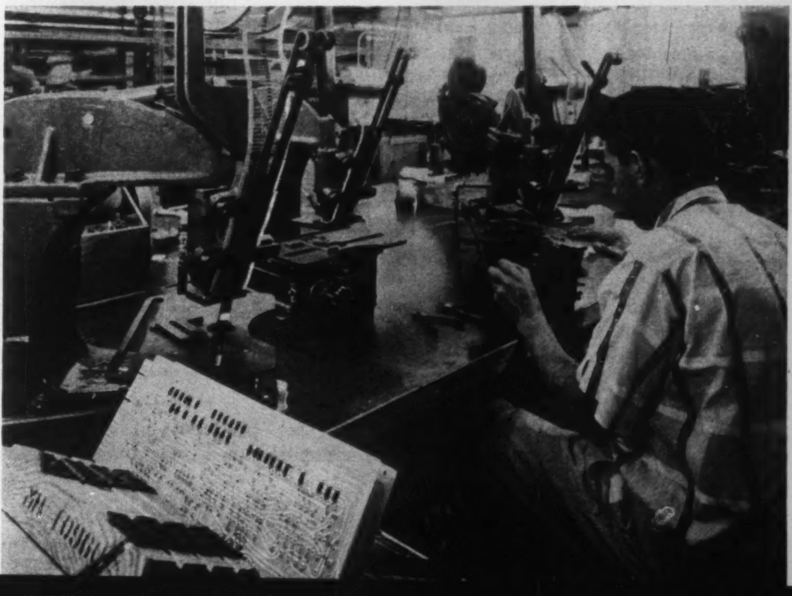

Fig. 2—Most of the components are inserted by automatic machines which remove components from rolls, cut the component leads to length, insert the leads in preselected eyelets in circuit boards, and crimp the projecting lead ends to secure the components to the boards. One operator can tend and load three machines. Dynasert machines used were built by United Shoe Machinery Corp.

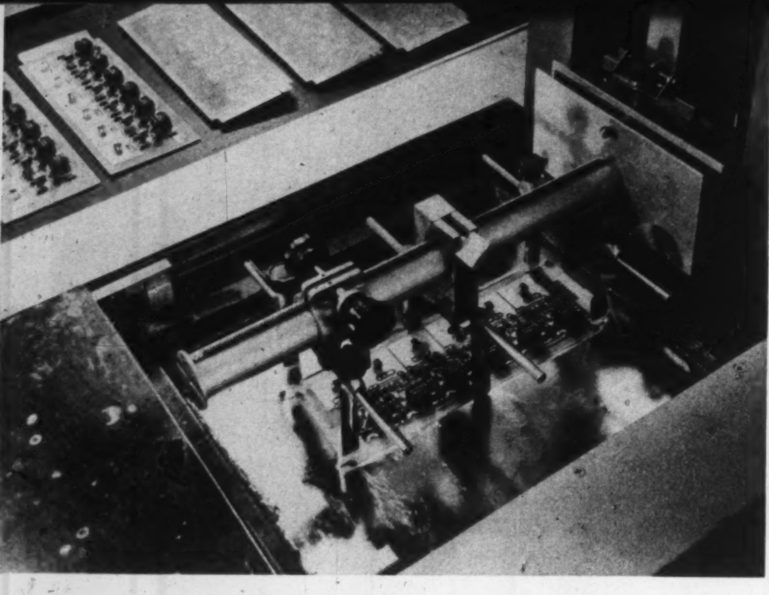

Fig. 3—At dip soldering station, bottom surfaces of circuit boards are dipped in molten solder for 4 seconds. Dipping process automatically connects component leads and wires to circuits printed on boards.

program are of interest from the standpoint of what was accomplished in raising the production rate for a line of relatively complex subunits that are traditionally made almost entirely by hand.

In one of the improved operations, printed wiring boards received from a processing area are drilled to receive eyelets, rivets, and terminals. Hole location information for the drilling operation is taken from engineering drawings that also show the type of fastener or terminal associated with each hole.

A line of five machines, *Fig.* 1, is next used to assemble eyelets in appropriate holes in the printed wiring boards. Total capacity of the line is 60,000 operations per shift, with eyelets ranging in size from 0.048 to 1/8-inch. Assembled eyelets act as receptacles for electronic components.

In the next step, components such as switching diodes and resistors are assembled to the boards by a bank of 13 modified Dynasert machines, *Fig.* 2. These units automatically trim the lead wires on the components to size, insert the leads through the openings in preselected eyelets, and bend the projecting ends of leads to secure the components mechanically in place.

One operator can tend and load up to three Dynasert machines. A stop is set on each machine to help align the boards so that particular eyelets are positioned under the workhead. Components are fed to each workhead from a roll formed by pressure sensitive tapes that support the components at their ends. The larger Dynasert machines are equipped with ratchet feed mechanisms whereby each circuit board may be positioned in several locations to receive multiple components.

Some components must be assembled to the boards by hand. Where possible, the leads of these components are cut and preformed in a special machine provided for the purpose. Components may be fed into this machine by a hopper and gravity feed, or taped rolls may be used as for the insertion machines. Still other components—such as transformers, transistors, and relays—must be assembled entirely by hand because of their size, shape, and number of leads. Rivets may be set to hold the components, or their mounting brackets, in place. These operations are normally performed after the machine forming and assembly operations.

When all of the assembly operations have been completed, an inspector checks each board to see that it has a full complement of components, each securely fastened in the proper place on the board. Records of the inspection results are kept for quality control purposes.

Circuit board assemblies that pass inspection are next washed in hot detergent solution to remove all contamination and grease. They are then brushed and air dried. Following these operations, the boards are masked. In this operation, parts such as terminal connections are coated with a masking material so that solder will not adhere to them in a subsequent dip soldering operation. The masking material is easily removed after soldering.

Masked boards are dipped in soldering flux and then passed to an infra-red preheating station. Preheating eliminates all traces of moisture, and brings the boards to a temperature closer to that of the molten solder at the next station.

At the dip soldering station, *Fig.* 3, the boards are loaded, one at a time, in a fixture that supports them horizontally over a solder tank. The boards are held by fluoroplastic fingers that can be immersed in the molten solder without harm. After loading a board in the fixture, the operator initiates an automatic 4-second dip cycle during which all wires and component leads are connected to the circuits printed on the boards. The temperature of the solder is normally maintained between 470 and 490 F, but operation at 500 F is possible.

After the boards are removed from the solder dip they are given another hot detergent wash to remove adhering traces of flux. Following an air drying operation, they are inspected to ensure that there are no soldering defects. Acceptable boards are then ready for assembly in the final equipment.

APPLYING TELEPHONE RELAYS

By L. B. MITCHELL
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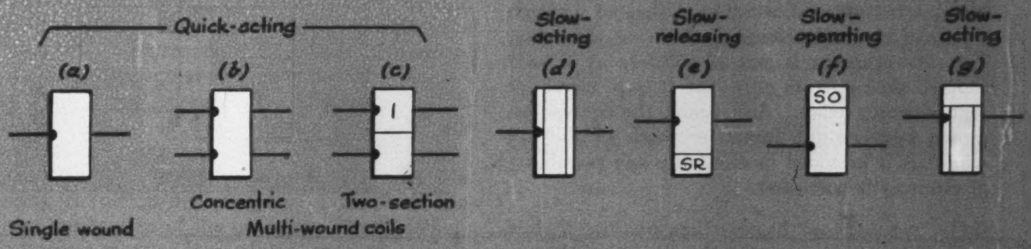
AUTOMATIC telephone switching was pioneered more than 60 years ago. Since that time, many kinds of telephone-type relays have been designed and proved in use. Relays differ in such aspects as the number of contact pairs and their operating arrangements; the coil windings; power requirements; the current that contacts can carry; and the speed of acting. Paralleling the advances in components used in switching circuits, both theoretical and practical aspects of switching circuit design have been extensively developed. As an example, the growth of the relatively new, and sizable, data processing industry reflects these developments. The variety of telephone relays and the highly developed application techniques suggest that industrial users have available an important reservoir of know-how deserving of the closest examination.

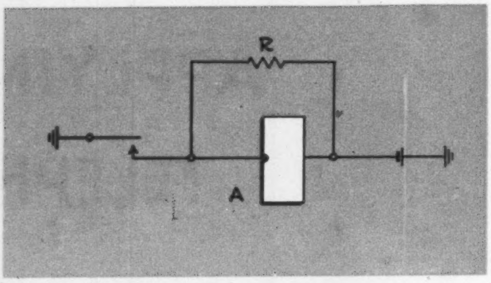
Certain basic relay combinations and characteristics that have proved useful in telephony are readily adaptable to industrial applications. This is the first in a series of data sheets that will highlight a few of these basic circuits. Since these data sheets are meant to deal only with general circuit configurations, specific electrical parameters or component values are not considered.

Coil Symbols

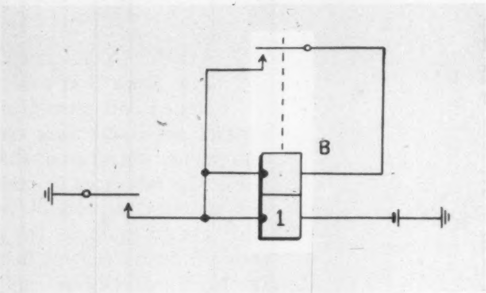


Relay coil symbols to be used in this series of data sheets are as follows: (*a*)—Single-wound, quick-acting coil. Used for general service in noncritical timing applications and, with special engineering, in high speed quick-acting applications. (*b*)—Double-concentric-wound, quick-acting coil. Used for isolating operating and/or locking circuits, bias coil, differential, and "buck-down" circuits. (*c*)—Double-wound, two-section, quick-acting coil. Used for isolating operating and/or locking circuits, bias coil, differential, "buck-down," and battery feed or retard coil circuits. (*d*)—Single-wound, slow-acting, sleeved core coil. Used when operating and release delays are desired. The conductive metal sleeve over the core affects the normal buildup and decay of magnetic flux as the current state of a coil changes. (*e*)—Single-wound, heel-end slugged coil. Used where release delay is desired. (*f*)—Single-wound, armature-end slugged coil. Used where operate delay is desired. A cylindrical metal slug, mounted at either end of coil, can selectively influence buildup and decay of magnetic flux. (*g*)—Single-wound, armature-end slugged and sleeved core coil. Special coil characteristics enable the coil to accept ac without operating, but passage of dc will operate coil in manner normal for slow-acting coils.

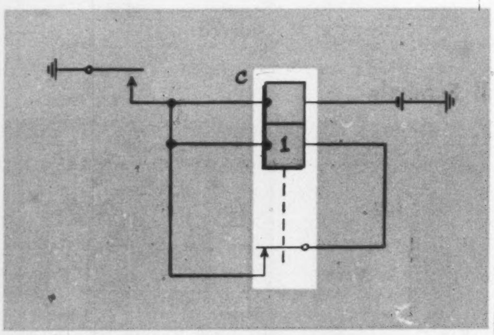
There are many other special coil arrangements available. Some provide noninductive shunts wound on top of a single-wound coil; others provide series resistive windings; and still others provide combinations of slugs, sleeves, multiple windings, and special core alloys. The special core alloys are used in conjunction with similar alloys in the relay structure where high permeability characteristics are desired.



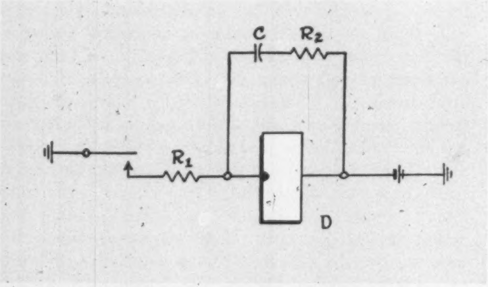
Slow-Release by Noninductive Shunt — A slight increase in the normal release time of relay *A* can be provided by means of a noninductive resistor connected across the relay coil. This shunt path provides means for the back emf (normal when any relay coil is de-energized) to circulate and somewhat prolong the operated condition of the relay.



Slow-Release by Shorted Heel-End Winding—Relay *B* contains a two-section, quick-acting coil which is energized and de-energized on its armature-end, number 1 winding. A pair of normally open contacts on the relay will short the number 2, heel-end winding when the relay is energized. The shorted coil acts somewhat as a heel-end slug. This shorted winding is only partially as efficient as a solid copper slug, but it will provide some increase in release time when the relay is de-energized. The input terminals of the two coil windings are connected so that the number 2 winding will have a negative potential standing on it when the relay is idle. This eliminates any possibility of electrolytic corrosion on the number 2 winding and associated wiring.

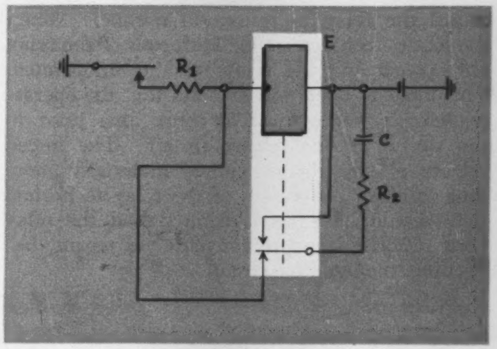


Slow-Operate by Shorted Armature-End Winding—The circuit for relay *C* is the converse of that for relay *B*. In this case the relay is energized and de-energized on its number 2, heel-end winding. Prior to operation, the number 1, armature-end winding is shorted through a pair of normally closed contacts on the relay. This arrangement is not as efficient as a solid copper, slow-operate slug but it will introduce some operate delay. And again, the connection shown between the input terminals of the coil windings is provided to eliminate any possibility of electrolytic corrosion.



Slow-Operate and Release by Resistor-Condenser Shunt—The circuit illustrated for relay *D* provides both slow-operate and slow-release actions for a normally quick-acting relay. The effectiveness depends upon the values of the applied voltage, coil resistance, external resistance, and capacitance. When the operating contacts close, operation of the relay cannot take place until the shunt condenser becomes sufficiently charged. Similarly, upon opening of the contacts, the relay will not restore until the condenser has discharged through the relay coil circuit. It is to be noted that resistor R_1 limits the current available for charging the condenser and operating the relay. Because of this marginal arrangement, the circuit is voltage sensitive. Timing will change somewhat if the applied voltage changes.

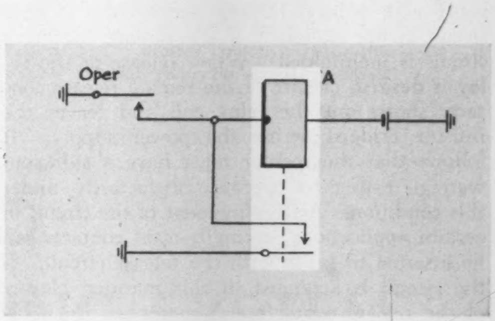
Slow-Operate by Switched Resistor-Condenser Shunt—This circuit provides the same operate delay as that shown for relay *D* but, once relay *E* is operated, the resistance-capacitance network is discharged locally and there is no release delay introduced. Resistor R_2 might be placed in series with the normally open contact rather than in series with the condenser. Timing will then be a function of resistance-capacitance applied voltage, and the operating characteristics of the relay. This timing will shift if any component value is changed. As with the circuit for relay *D*, this circuit is voltage sensitive because of the marginal arrangement of the relay coil and the resistor.

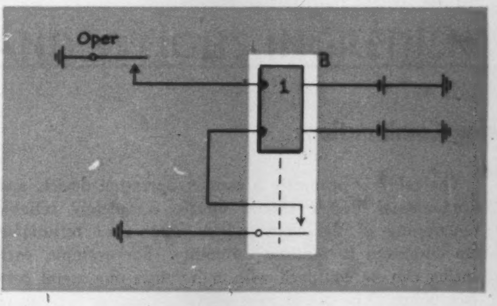


Lock and Release Circuits

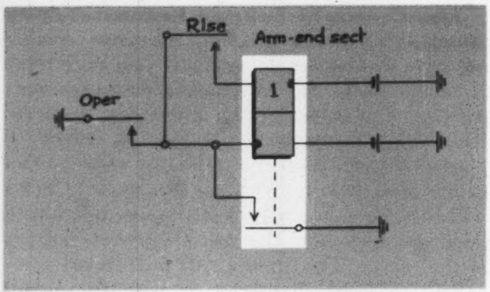
Locking On Operating or Auxiliary Winding.—The arrangement for relay *A* provides for the relay to lock itself in an operated condition as a function of some remote operating signal. Often, however, it will be found to be impractical to lock a relay coil in the manner shown for relay *A* because the locking potential will be fed backward over the operating lead and will cause a malfunction at some other point in the circuit. These "sneak" or "feedback" circuit effects can be eliminated by means of a blocking diode in series with the operating lead. An alternate means of eliminating this problem is shown for relay *B*, which contains a multiwound coil. In this arrangement, the relay is operated on its number 1 winding and locks itself in the operated condition on its number 2 winding.

In either of the circuits, the usual normally-open (*A* type) spring combination can provide for the locking circuit. This is the more desirable way of arranging the contacts. However, if the operating signal is of extremely short duration, such that there is some question as to whether or not it will operate the relay, the locking contact can be provided as a preliminary-make type. With a relay of this type only the locking circuit spring moves as a result of the initial application of the operating signal. When the locking contacts have closed, the relay armature will continue to operate and pick up the balance of the spring load—being driven both by the locking winding and the operating winding if the operating signal is still present. It is a mechanical necessity that a relay equipped with a preliminary-make contact be also equipped with a stiff normally-closed back contact. This provides that the balance of the spring load above the preliminary-make spring is supported in a position such that the preliminary-make spring is free to move when the relay is energized. This heavy normally-closed contact must be provided even though the circuit does not require it.

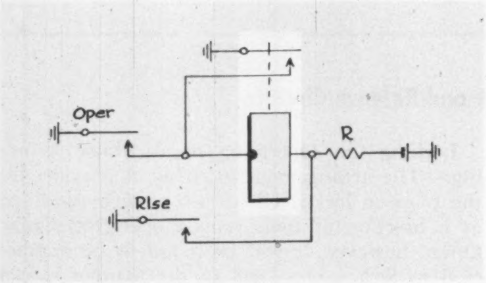




Forced Release of Double-Wound Relay—As a function, of some remote operating signal, the relay in this circuit is operated and locks itself in the operated position by means of its number 2 winding. The relay is caused to return to its normal state by closure of the release contacts. The closure of these contacts causes the locking potential to be connected to the number 1 winding of the relay, which is arranged in a manner such that the generated ampere-turns have a counter magnetic effect on the existing ampere-turns generated by the number 2 winding. This causes the relay to restore to normal. When the locking contacts break, both coils of the relay are opened and the relay remains unoperated. This mode of operation assumes that the operating circuit was opened at some time prior to the closure of the release circuit. The forced release of the relay requires materially more time to effect restoration of the relay to normal than would have been required had the relay been restored by more conventional means, i.e., opening the holding circuit.

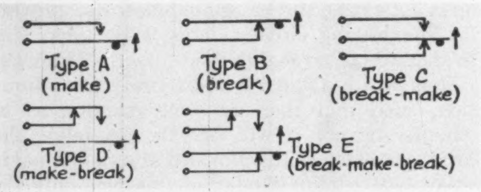


Shunt Release of Single-Wound Relay—The relay in this circuit is operated in series with an associated resistor. As illustrated, the relay is operated from some remote point and is provided with a local locking circuit (the locking circuit is not necessary if the remote operating circuit is maintained). When release of the relay is desired, closure of the remote release contacts shorts out the relay coil and leaves the resistor bridged across the power supply. It follows that the resistor must have a sufficient wattage rating to operate satisfactorily under this condition. As a refinement of the circuit in certain applications, normally-open contacts can be inserted in series with the release circuit. If the circuit is arranged in this manner, closure of the release contacts at times when the relay was not operated would not cause the power supply to be connected across the resistor.



In general, shunt circuits of this type are more satisfactory on higher voltages than on lower voltages. The limiting factor is the current which must be handled by the operate and locking contacts, as well as the release contacts, in obtaining relay actuation when the voltage is low.

Spring Combinations



The relay is primarily a contact operating device, and fundamental design should ensure completely reliable functioning of the contacts. A number of techniques are employed to increase reliability. For example, each spring can be equipped with more than one metal contact point. The use of twin contacts provides for greater reliability of operations in that the probability of both contacts simultaneously failing is small.

The spring assembly, or spring pile-up, of a relay is made up of a number of springs that are clamped to the frame of the relay at one end and are free to move at the other. The springs are insulated from each other and the frame of the relay. For circuit reliability, relay spring sets should be so designed that contact pressures and contact openings can be easily maintained.

The primary spring combinations are shown in the diagram. The forms are standardized to the extent that the associated letter designations can be used to identify a particular type, i.e. typically a type *A* spring combination is a make, or normally open, type. The spring pile-up of a given relay is made by combining the primary types, and most requirements can be satisfied by such combinations. Two other forms that should be mentioned are the early acting type X, and the late acting, type *Y*. As suggested by their descriptive names, the type X contains one contact that functions before all other contacts. The type *Y* contains one contact that functions after all other contacts.

There is a practical limitation to the number of springs that can be placed in a spring pile-up and operated by a relay armature. As part of the circuit design function, then, an attempt is normally made to simplify the total spring requirements. For instance, in a circuit involving a given relay in which there is a need for a break and a make contact pair (type *A* and *B*), it might be possible to specify a combination break-make arrangement (type *C*). The simpler transfer combination requires only three springs in contrast to the four if separate make and break spring sets were used.

In addition to using fewer springs to accomplish a certain combination switching operation, types *D* and *E* insure the continuity of a signal during a transfer. These two types are important where a circuit interruption during switching could not be tolerated at some point in the system.

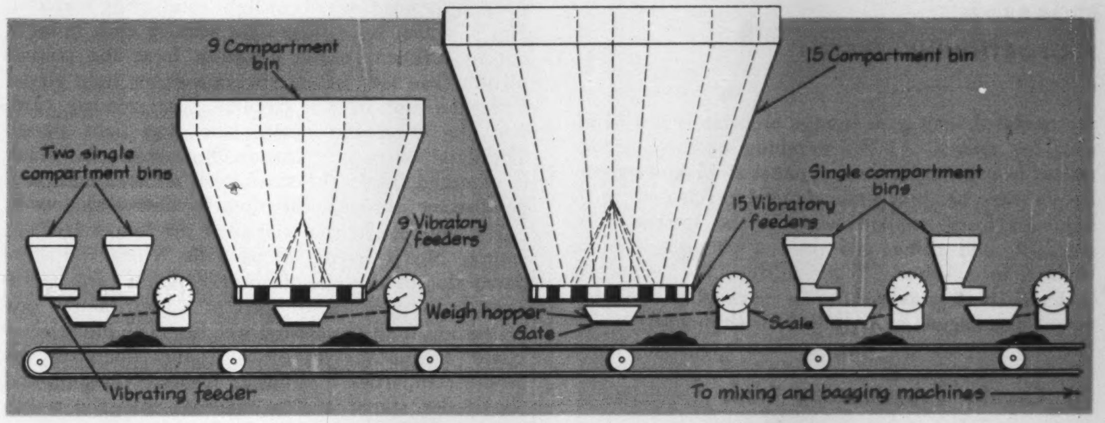


Fig. 1—Elevation view shows a representation of an automatic system for selecting, proportioning, and conveying various ingredients used in the manufacture of refractory products. The system uses four single-compartment storage bins and two multi-compartment bins. Materials are selectively released in a sequence from each bin compartment as programmed on a bin selector board at a master control panel. The weight of each material released is controlled by circular punched cards mounted in each scale head.

PROGRAMMED PROPORTIONING SYSTEM

SELECTS AND WEIGHS INGREDIENTS

Automatic systems for proportioning and mixing two or more materials become increasingly complex and space-consuming as the variety of product mixes increases. The system described by the author simplifies the problem by storing a number of materials in sectionalized bins and by using a method of automatic programming and cumulative weighing to select and discharge materials to the mixing process.

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TWENTY-EIGHT types of raw materials are used in the manufacture of miscellaneous refractory products at the Augusta, Ga., plant of the Refractories Div., Babcock & Wilcox Co. Each product requires various combinations and proportions of the many different raw materials. An automatic system for selecting, proportioning, mixing, and bagging materials for the various refractory products has been designed and built by General Electric Co. and Stephens-Adamson Mfg. Co.

Incoming raw materials are carried on an overhead conveyor system and deposited in one of six separate storage bins. Several of the bins are divided into a number of compartments whose size depends upon the amount of a particular raw material handled, Fig. 1. For a given product mix, only certain compartments in the sectionalized bins will contain the desired raw materials.

Associated with each storage bin system is a batch weighing system. All five weighing systems are controlled from a master control panel at which raw materials can be programmed to be released in a sequence from compartments in the storage bins, weighed, and discharged onto a conveyor system leading to a mixer. After mixing, the composite material is transported to a packaging machine where it is bagged and readied for shipment.

Circular Programming Cards

Product ingredients are programmed on the master control panel by means of bin selector boards. For a given batch an operator selects the bin selector board which corresponds to the compartments of the six bins which contain the required raw materials. The bin selector board is inserted in the front of the master control panel to code the control system correctly. Some bins will supply more than one ingredient for a particular product mix, and, in these cases, the materials are individually released from each compartment into a weighing hopper in a sequence and cumulatively weighed until all materials from a selected bin have been added to the mix. The weigh hoppers are dumped onto a take-away conveyor after all bins have been processed. The bin selector board thus automatically sequences the system to release material compartment by compartment concurrently at the several bins.

Proper weight for each raw material released from each bin compartment is controlled by a scale head, Fig. 2, associated with a particular bin. The weighing process at each scale head is controlled by circular programming cards which are mounted on the face of the scale heads. Punched into the opaque programming cards are two radial slots for each compartment weight of material required. One is a "slow-down" slot which begins at a lower weight than required and slows down the compartment vibrating feeder that is feeding material into the scale hopper. The second slot corresponds to the exact weight of desired material and stops the feeding process. If a second material is programmed from another compartment of the same bin, a second series of slots is punched into the card at the radial point of the cumulative weight of both materials. This method allows the compartments in a bin to be programmed for release of material as required, and the control checks after each successive weight to be sure the weight of the material fed from the given compartment has not exceeded the desired weight.

Sensing Weight Measurements

The scale head uses a standard type of radial pointer for visual indication of weight. Mounted on the pointer are two rods of light-conducting material, Fig. 3, which have their light sensing ends brought out at different radial distances from the pointer pivot. One rod detects the slow-down light signal from the slot in the circular programming card, and the other rod detects the stop light signal. The light source is a circular fluorescent tube which is mounted inside the scale head so that light will be directed through the slots in the opaque card.

For example, if the weight of the first ingredient from a bin is desired to be 9 lbs 6 ozs, the slow-down slot in the opaque programming card would have been punched to start at approximately one pound less than the desired weight. The bin selector board at the master control panel energizes the proper compartment vibrating feeder of the bin, and the feeder starts feeding material into the weigh hopper. When 8 lbs 6 ozs of material have been fed into the hopper, the scale pointer has moved to a point where the slow-down rod senses light from the slot in the card. This light is transmitted up the rod to a cadmium-sulfide cell mounted on the axis of the pointer pivot. The slow-down signal is amplified and used to actuate a relay to slowdown the feeding mechanism to a dribble. The stop slot in the card is punched at exactly 9 lbs 6 ozs, and when this weight is reached, the stop light sensing rod senses light through the slot, transmits it to a second cadmium-sulfide cell at the pointer pivot,

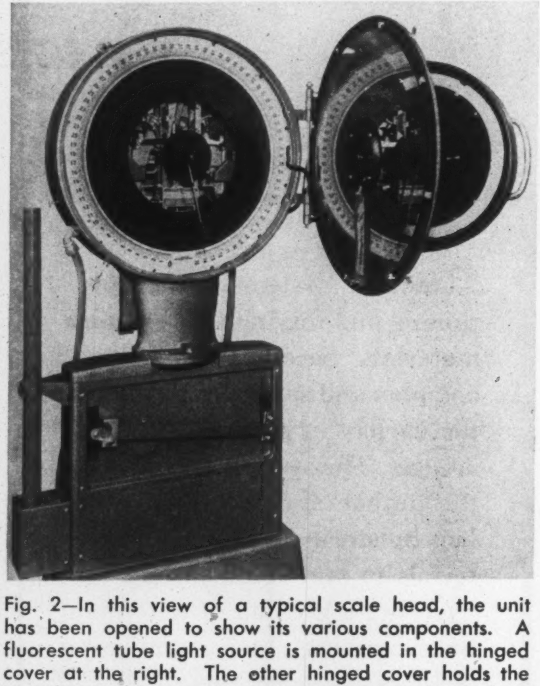
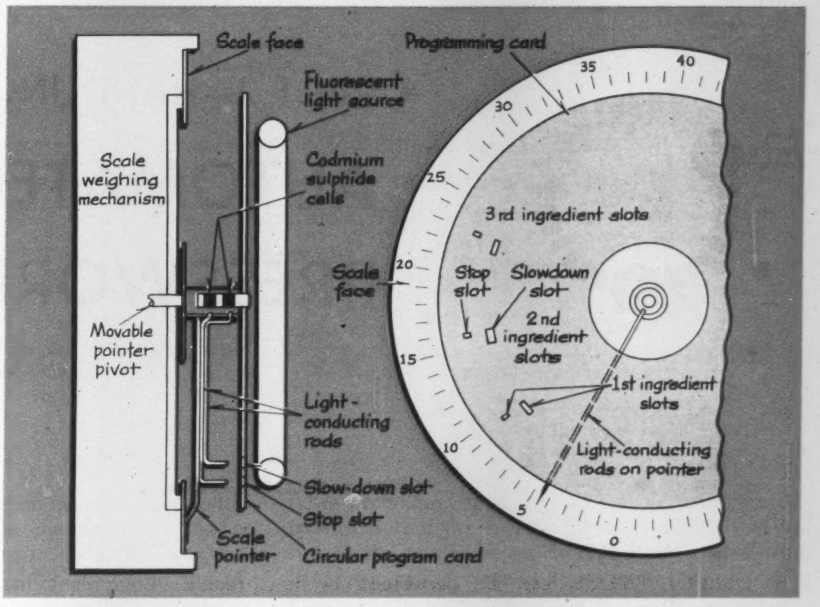


Fig. 2—In this view of a typical scale head, the unit has been opened to show its various components. A fluorescent tube light source is mounted in the hinged cover at the right. The other hinged cover holds the interchangeable circular programming card which is used to control the feeding rate of the vibratory compartment feeders. On the pointer of the scale are located sensing rods which transmit light to cadmium-sulfide cells mounted on the axis of the pointer pivot.

Fig. 3—Diagrams illustrate the weight detection method used in the scale heads. As the weight in a hopper causes the pointer to rotate, the slow-down light-conducting rod picks up fluorescent light shining through the slow-down slot in the circular card. This light is transmitted to a sensing cell mounted on the pointer pivot, actuating relays to change the speed of the compartment feeder. When the stop light-conducting rod picks up light through the stop slot, the second cadmium-sulfide cell energizes relays to stop the feeder.



and initiates similar circuits to stop the feed.

After the weighing sequence for the first ingredient has stopped, a check is made to ensure that the pointer is still directly behind the stop slot. The bin selector board then permits the sequencing of the control to the next compartment of the bin from which material is required, say 6 lbs 8 ozs. Therefore, the programming card would have a second slow-down slot punched at 14 lbs 14 ozs, and a stop slot punched at 15 lbs 14 ozs. After the weighing sequence for this compartment is completed in a manner similar to the first sequence, the bin compartment selector board again sequences the control to the next selected compartment until all materials from this bin have been fed into the weighing hopper. The weighing sequence is accomplished simultaneously at all bins to speed the over-all cycle time.

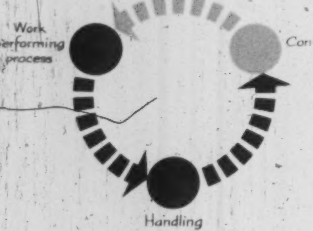
False Weight Protection

After all bins have fed the programmed ingredients into their respective scale weigh hoppers, a signal is received by the master control panel, and the five weigh hoppers are dumped onto the take-away conveyors. When a zero load condition again exists at each of the scales, the weighing cycle for the individual hoppers can be repeated. Approximate time for a complete weighing cycle from all five weigh hoppers is 4 minutes. If a compartment in a bin empties prior to completion of an automatic weighing cycle, an incomplete sequence will occur. The weigh hoppers will not discharge and the process cycle will not repeat until corrective action has been taken by the operator. Similarly, if an overweight in a hopper occurs during a weighing cycle, the control will be stopped and an alarm will sound.

For each formulation or batch of refractory product ingredients, there is a set of five circular program cards for the scales and one associated bin selector board. Changes in mixes are quickly and easily made by the operator. For each change, the process is stopped, the proper program cards are changed in the scales, and the bin selector board is changed at the master control panel. The process is again started and continues automatically until stopped by the operator or until a malfunction occurs.

can we help?

It has been pointedly mentioned at various times that in engineering automated systems new as well as old techniques and devices may prove extremely useful. Practical results require the investigation of all available equipment that can contribute to the effective development of suitable automatic lines. Information on such equipment is presented in various departments of the magazine each month as useful data become available. To aid in obtaining detailed data for further evaluation a post card is included on page 19. Take advantage of this service. The Editors will be glad to help in this or any other way.



PART 2—HANDLING FOR AUTOMATED PRESSWORKING

By **LEE D. MILLER**, Associate Editor

USEFUL WORK can be performed by a press only when material is consistently moved into and out of its workstations. Human hands have been used as mechanisms to accomplish this handling function; but it is neither practical nor humane to expect an operator to manually load and unload a press being cycled at high speed. Advances in handling equipment for press operations have therefore been in great demand. As a result, handling improvements have probably been the most readily apparent change in pressrooms. Equipment has been developed to automatically feed material into a press, move it from station to station within the press as required, and remove it from the press.

▶ Incremental Feeding

One of the important trends in press feeding has been the increase in feeding of stock from coils. One example of the economic reasons for this trend points

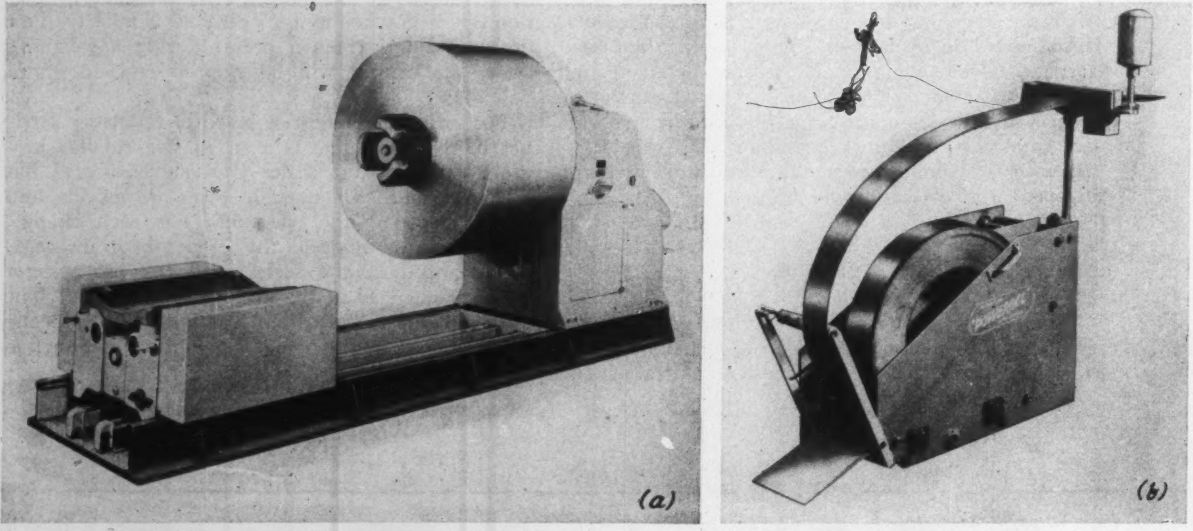


Fig. 13—Devices to pay off stock from coils are roughly divided into two types—reels and cradles. Reel at (a) features a loading car which moves the coil over collapsed arms of the reel. Arms in this reel unit built by F. J. Littell Machine Co. are hydraulically expanded to hold the coil and center properly. Reel is driven by a 5 hp variable speed drive. Cradle at (b) provides power-driven rollers to support and rotate coil. Medelton Co. Inc. supplies this unit complete with a cleaning and oiling attachment. Power to rolls is turned *On* and *Off* by switch detecting amount of slack in loop to cleaning attachment.

Efficient high speed pressworking requires automatic devices to handle stock and pieceparts. Broad selections of handling devices are now available as separate units or built into the presses themselves. This discussion of various handling arrangements is the second part of a three-part series covering equipment for automated pressworking.

to an 8 per cent reduction in material costs with an 83 per cent reduction in machine-hours for a trapezoidal blank.* Comparison in that case was between use of rectangular sheet stock and use of coil stock.

To use coil stock in a press, at least two types of equipment are required—means to pay off material from the coil and means to feed the material into the press in time with press operation. Many installations require additional equipment, but these two types are essential.

Generally the payoff means are classed as reel types or cradle types, *Fig.* 13. Essentially the difference is that the reel type locates a coil from the coil center, while the cradle type locates a coil from its periphery. The reel types quite often have a rotatable mandrel on which the coil is mounted. However, a pair of opposed conical spindles is sometimes used to grip and support the coil. For heavy coils the reels or cradles can have associated coil cars or ramps that hold succeeding coils and feed them into position. Such provisions avoid delays caused by unavailability of cranes or lift trucks when a new coil is required.

Roll feeds driven mechanically from the crankshaft of the press are widely used for synchronized feeding of coil stock and flat strips into a press. They are available as single roll feeds and as double roll feeds.

In a single roll feed, the stock is passed between a pair of rolls which grip the stock and advance it when they are turned. A single roll feed may be mounted on either side of a press and operated to push material into the dies or pull it out of the dies if the ribbon is not severed. A common arrangement is to mount a single roll feed on the left side of the press and advance the stock from left to right. If the stock is in relatively short lengths such as flat strips this arrangement is not very efficient. This is true because, if it is to be used completely, the stock must be fed by hand after the trailing edge leaves the feed rolls. Also, light stock may buckle and jam the equipment when this pushing arrangement is used.

A double roll feed uses two pairs of feed rolls, one pair on each side of the press. When a ribbon of scrap is left after the press operation, it passes

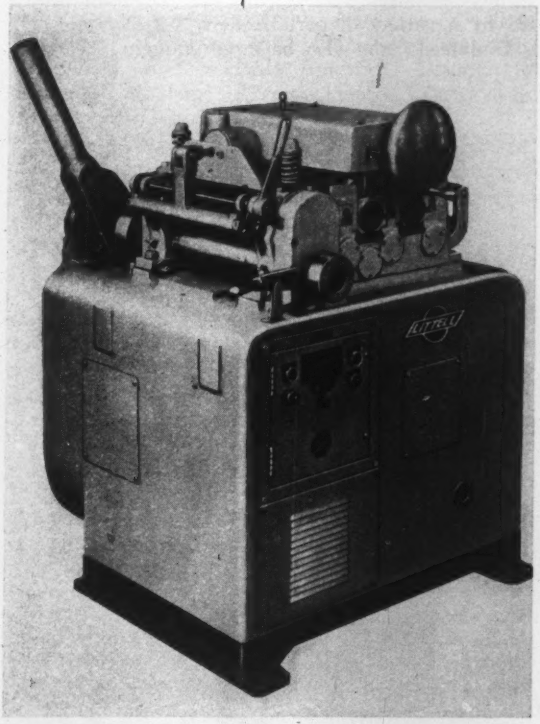


Fig. 14—Stock from coils can be straightened and fed into a press by this combination 5-roll straightener plus feeder made by F. J. Littell Machine Co. The hydraulically driven machine is electrically controlled by operation of the press. Special feature of this particular model is provision to automatically lift top rolls clear of stock on each cycle so pilots can adjust stock location in progressive dies.

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*J. F. Lyden, "Automation Applied to Sheet Metal Blanking," AUTOMATION, Vol. 3, No. 1, January 1956, pg. 34.

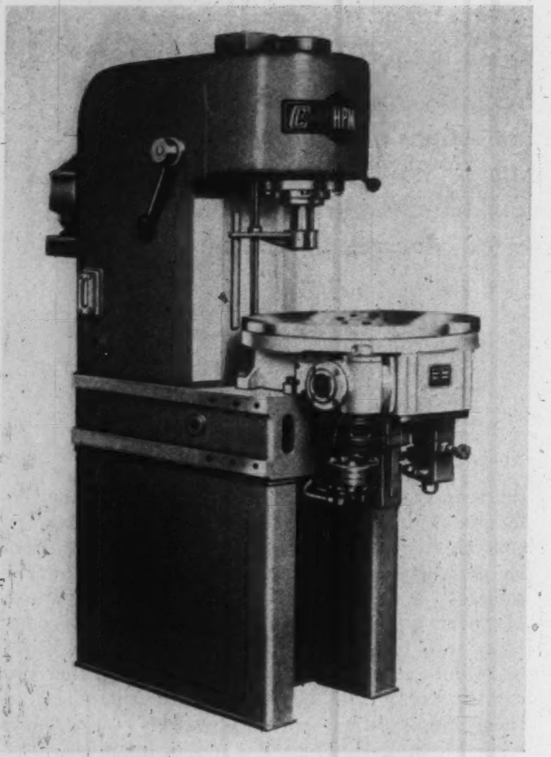

Fig. 15—Dial feeds have been used for many years to feed discrete parts into presses. As shown on this unit built by Hydraulic Press Mfg. Co., dial feeds are available as integral equipment on many new presses.

out of the press through the second pair of rolls. They continue to mechanically advance the stock even after the tail end of the strip has left the infeed rolls.

Reciprocating feeds are also available to intermittently advance coil or strip stock into the press. Basis for these feeds is a clamping arrangement that grips the stock while the clamp advances linearly in the direction of feed. At the end of its advance stroke, the clamp is opened and then retracted. Many of these feeds are powered mechanically from the press. Others are driven pneumatically in synchronization with press cycles.

Though not always required, stock straighteners are frequently used between the payoff and feeding devices. Often they are combined with the payoff and/or feeding elements in a single piece of equipment, *Fig.* 14. The straighteners remove coil curvature from stock by the action of a series of rolls. Units are controlled to straighten stock intermittently as required by the press.

Independent straightening machines are powered by their own electric motors. One common type of independent straightener control is a switch actuated by an arm whose position is determined by the amount of slack in the strip between straightener and press. Combination feeding and straightening units, of course, must be synchronized directly with press cycles.

Brushing or other cleaning devices are required in some cases, also lubricators or oilers. Many designs of such units are available for specific requirements. Provisions for automatically cleaning and oiling stock as it is fed to a press have led to improved quality of work produced and a reduction in rejects.

▶ Feeding Discrete Parts

Jobs requiring the feeding of sheets or blanks one at a time into a press are found in all types of pressworking. Because of the wide range of applications a great variety of equipment designs have been developed to suit specific needs. The manufacturing engineer's choice of method for a certain application is, naturally, dependent on the factors surrounding the particular job.

One of the early developments for feeding of blanks or previously worked pieceparts was the dial feed. Such feeds are now available for attachment to existing presses and as integral equipment on new presses, *Fig.* 15. In their simplest applications, dial feeds are used as indexing devices between a manual loading station and the dies in the press. In more elaborate versions they can be automatically fed by a variety of parts feeders.

Dial feeds may also be large enough to carry a

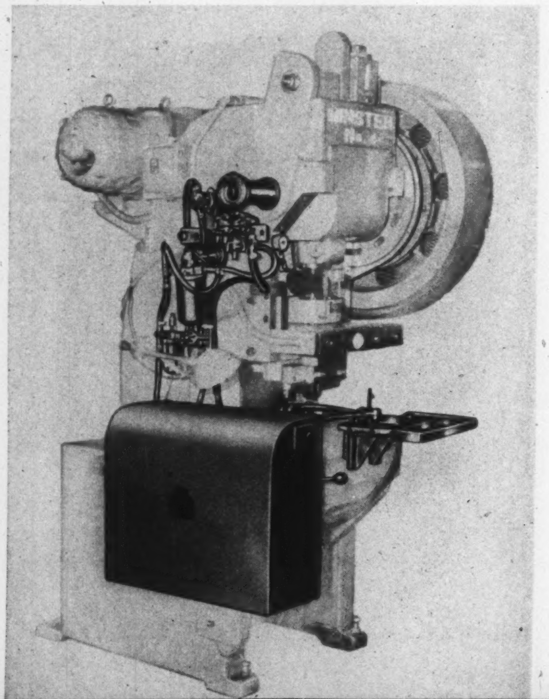

Fig. 16—Arm type feeder made by Press Engineering Co. Inc. illustrates one of many designs available. In this application to a press built by Minster Machine Co., blanks are picked up from a table, deposited in the die, and ejected by the mechanical arm.

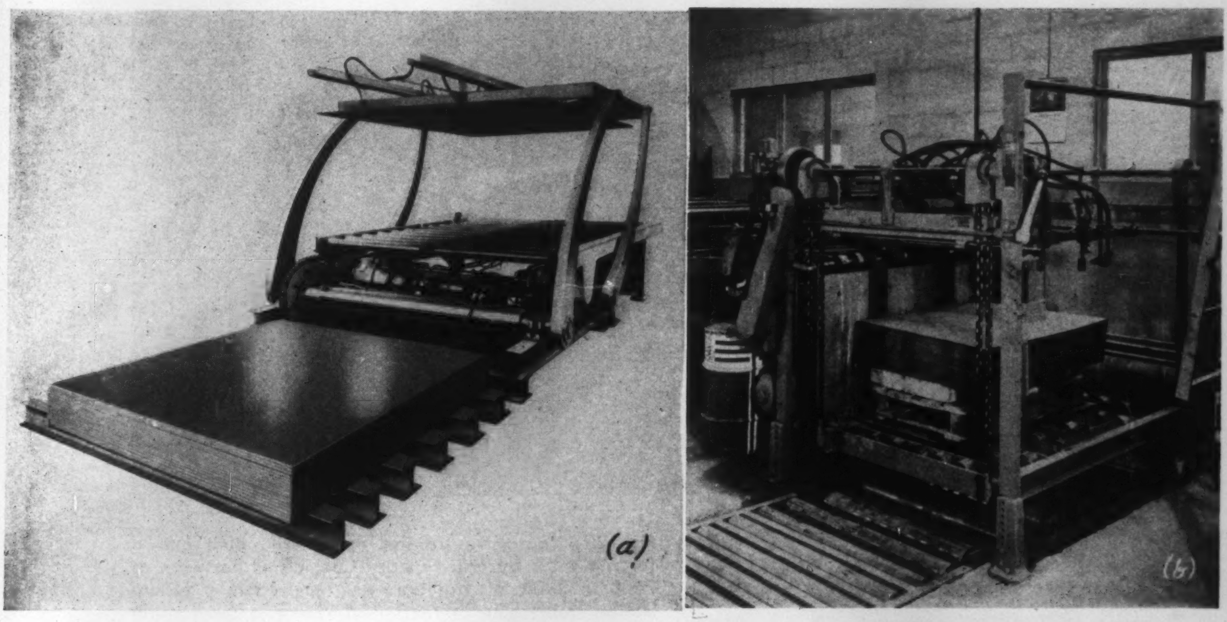

Fig. 17—Sheets and blanks can be fed into position in a press by conveyors supplied from supply stacks. Machine at (a) swings a frame with vacuum lifters down on stack, picks up the top sheet, swings the sheet over to the conveyor and releases it. The unit is built by Herr Equipment Corp. and includes a probe system to adjust the swing to the height of the stack. Sheet feeder at (b) is built by Dexter Co. Stack is automatically raised as top sheet is picked off by vacuum cups and moved into feed rollers. A blast of air is used to help separate it from the stack. Provision is made to load a new stack without interrupting the operation being fed.

part into and out of several operating stations involving machining or assembly operations as well as presswork. Problems in building and operating large dials are formidable, however. Usually, in fact, these problems are such that use of dial feeds is confined to relatively small workpieces.

Where size and shape permit, the parts can be fed directly into the press by gravity chutes from standard parts feeders such as vibratory bowls, elevating feeders, and similar units. Applications of these devices to feed presses are usually limited to pieceparts of small size.

Also popular for relatively small blanks and workpieces are various rotating arm devices, *Fig.* 16. Such units frequently combine vertical lifting and dropping motions with the swinging of an arm about a vertical axis. The blank or part to be fed is picked up by mechanical fingers, magnets, vacuum cups, or other means and placed in the die. These units frequently perform unloading operations in addition to loading the press. Usually driven mechanically by the press itself, these units are thus positively synchronized with press cycles.

Feeders employing a reciprocating element are

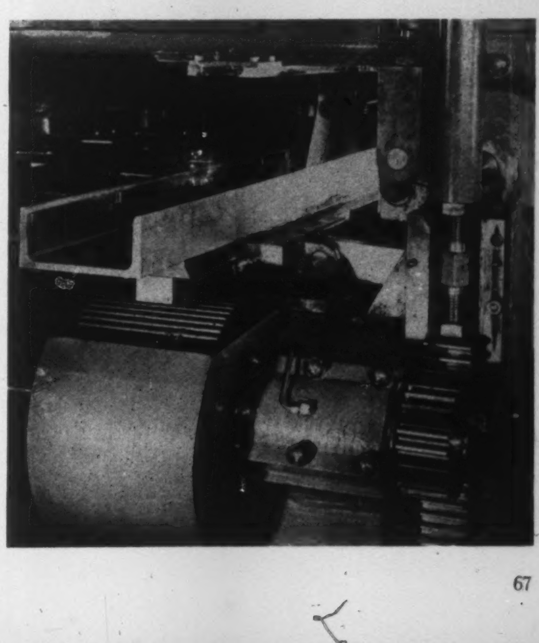

Fig. 18—Transfer drive shown is used with one of two channel bars on which fingers are rigidly mounted along full length of transfer path. Other channel and fingers are barely visible in background. Vertical rack at right is driven from press crankshaft to reciprocate channel. Channel is dovetailed into block driven by another linkage that slides this channel toward the other channel to grip workpieces. Transfer was built integral with press by E. W. Bliss Co.

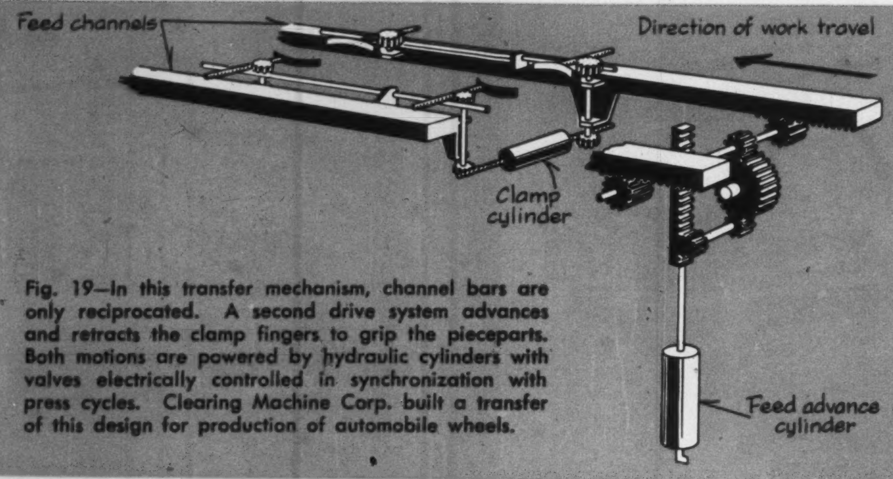

Fig. 19—In this transfer mechanism, channel bars are only reciprocated. A second drive system advances and retracts the clamp fingers to grip the pieceparts. Both motions are powered by hydraulic cylinders with valves electrically controlled in synchronization with press cycles. Clearing Machine Corp. built a transfer of this design for production of automobile wheels.

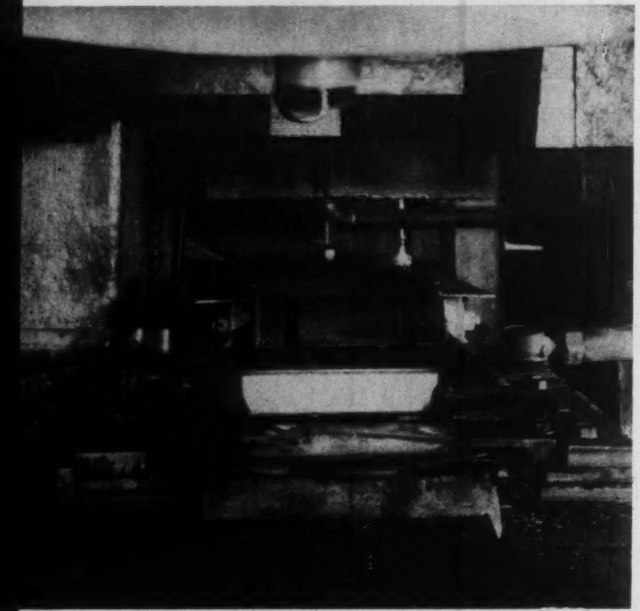

Fig. 20—Progressive transfer mechanism, built into a forging press by Erie Foundry Co., moves hot work at 2000 to 2400 F. Hot bars are received in a pickup station from chute at rear; indexed to a semiforging die, a finish forging die; and then ejected to chute in foreground.

used with both small and large pieceparts. The work is taken from a stack or supplying conveyor, moved into the die, and released. The reciprocating head is then retracted to take the next part. Various designs are commercially available to operate in this manner. Others are often custom-designed with a simple cylinder arrangement that slides the part along rails into the die. Walking beam arrangements are also used for such feeding, especially of larger parts.

When the workpiece to be fed is quite large, power conveyors may be used to feed it up against die stops and/or limit switches which cycle the press. Sheets and blanks are automatically fed to such conveyors from supply stacks, *Fig.* 17. Some of the feeders used in this manner have been developed with the aid of experience in feeding of paper sheets. Just one more example of the benefits of cross-fertilization of ideas from one industry to another.

▶ Intrapress Handling

More than one die station in a single press is often advantageous. But to set up a process in this

Fig. 21—Flip-over device built into transfer arrangement by Clearing Machine Corp. is mechanically controlled by the advance of the transfer bars. Fingers mounted on pivots are spring-loaded to move workpieces to a vertical position. Cutouts along runway allow fingers to rotate from flat position at one station, to vertical between stations; then cams turn them on over to flat position at next station, a 180-degree turnover.

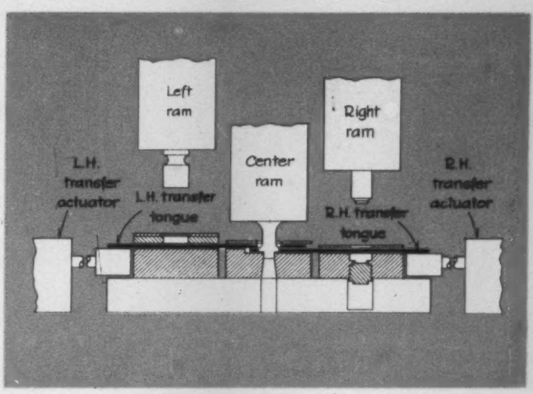

Fig. 22—Transfer arrangement, furnished by Multi-Autoform Corp. as part of the three-slide machine in *Fig.* 10, uses two transfer tongues. Mechanically driven by the press, the left tongue moves the part from the left die to the center die; the right tongue moves the part on to the right die.

manner requires a handling method to move the work from station to station. Where the part and stock being used lend themselves to use of progressive dies, conventional strip feeds have been used. The operations are performed in succession and the pieceparts are not completely severed from the strip until the final operation. Such processes have long been used, but, because of costs of progressive dies, are usually reserved for pieceparts to be run in very large quantities. Setups for such feeding arrangements are generally accompanied by an automatic scrap chopper to chop the scrap skeleton into lengths that are easily handled.

When separate workpieces are to be indexed through several stations in a press, reciprocating transfer mechanisms can be used. Usually, such mechanisms provide a pair of bars across the press and straddling the workstations. Means is provided to advance these bars lengthwise in the direction of feed and subsequently retract them. Provision is also made to bring fingers on opposing bars into contact with the pieceparts and carry them along on the advance stroke. This clamping may be accomplished by sliding the bars toward each other, *Fig.* 18; it may also be performed by moving the fingers out from the bars, *Fig.* 19. Where required, provision can also be made to lift and lower the pieceparts as part of the transfer action.

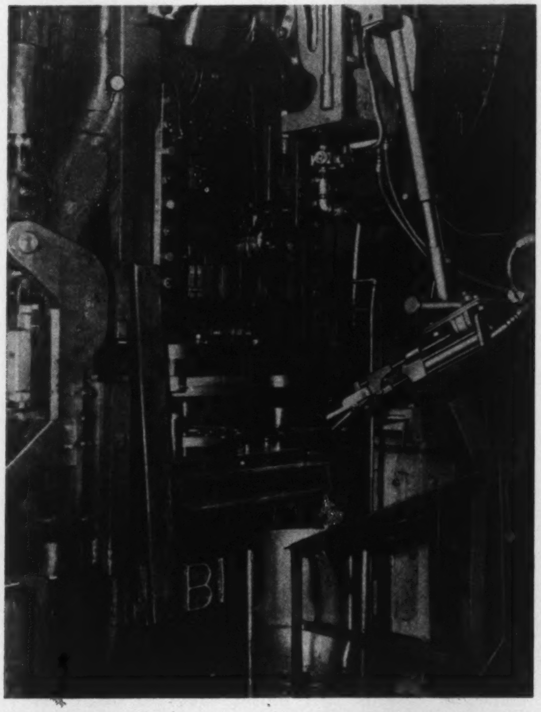

Fig. 23—Swinging arm extractor made by Sahlin Engineering Co. is shown unloading punched disc that will be dropped into stack in front of press. Motions of extractor are pneumatically actuated in time with press cycle.

Presses are offered with reciprocating transfer mechanisms built as part of the presses, *Fig.* 20. Independent units are also made for use with any press or line of presses. Both built-in and independent units are available for direct mechanical drive from a press or for separate synchronized actuation hydraulically or pneumatically. Since the distance between die stations must equal the length of transfer advance or a multiple of it, units are sometimes provided with adjustable advance strokes and finger spacings. Such adjustments allow a greater range of applications for a given transfer mechanism.

For rapid changeover of a press from one piecepart to another, individual fingers or complete bar assemblies can be made readily removable. Where such a design is used, a set of bars may be removed from the press with finger settings intact and stored with its associated dies until the next run of their particular piecepart.

Use of reciprocating transfer mechanisms allows many types of simple loading devices to be used in co-operation with the transfers to feed pieceparts into a press. Parts can be lifted off a feed stack by a simple mechanical, magnetic, or vacuum lifter, held until the transfer is retracted, and then dropped on transfer fingers; slides can be used to feed blanks from the bottom of a magazine; controlled gates or pins can be used to escape workpieces from chutes or conveyors.

The need to turn pieceparts over between some operations can be readily accomplished in many cases by simple pivots on the transfer fingers and cam action during the transfer advance. One such flip-over design is shown in *Fig.* 21.

Various other intrapress handling arrangements have been devised to suit particular requirements. One interesting design is illustrated by *Fig.* 22. Here two independent feeding tongues are mounted on opposite sides of a bank of three independent

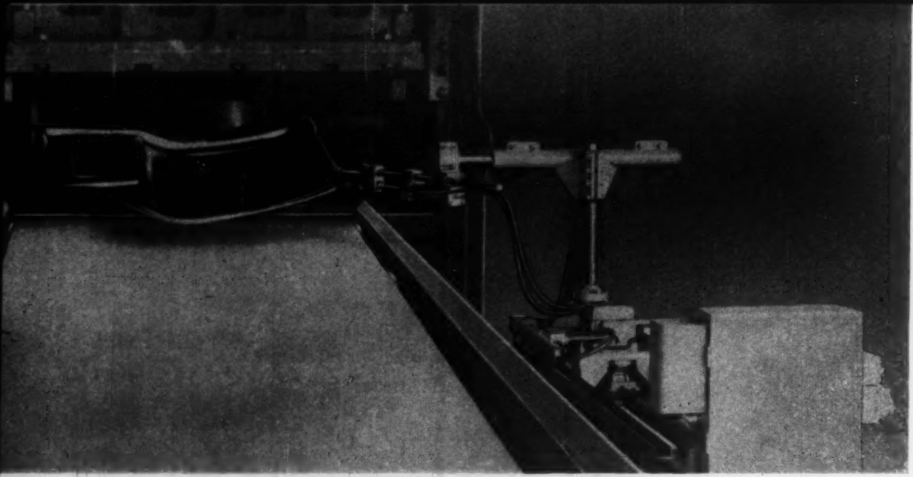

Fig. 24—Linear extractor that sits independently on floor near press offers a straight line motion of jaws into and out of the press. Unit shown is built by Die & Automation Inc., and is pneumatically operated.

slides. The two feeding tongues are simultaneously moved in opposite directions. Two separate parts can be made on the outside dies and moved to the center die for assembly.

▶ Unloading The Presses

The simplest automatic unloading plan is one that requires no unloading devices. Where it is applicable, as in the production of many blanks and small parts, construction of the dies may allow the punch to carry the part through the die and drop it into a conveying means. Nearly as simple are other plans which use ejector pins, kicker bars, or air blasts plus gravity to eject the work from the press.

Unfortunately, there are many cases in which these simple unloading plans can not be used. Shape and size of the part may prevent their use, or gravity may not be a strong enough force to reliably move parts at required speeds. In such cases, mechanical equipment is required to automatically contact the work and move it out of the press. If the operation is a multistation setup with a transfer mechanism, the mechanical equipment to deposit the work outside the press is already at hand; otherwise a separate device must be provided.

One of the solutions to many unloading problems is the swinging arm extractor, *Fig.* 23. Attached to presses of any size, this type of self-contained unit can be pneumatically powered and synchronized with press cycles. Both large and small parts can be unloaded with these devices—several being used together if the part so requires. Since jaws on the extractor clamp on the part, positive control of part unloading is provided.

Similar positive unloading is accomplished by linear extractors. One of many designs available is illustrated by *Fig.* 24. Available as independent portable units, they can be readily rolled from place to place as setups are changed. The clamping arm is advanced and retracted by a pneumatic cylinder whose operation is controlled from press cycles.

Linear motion is similarly provided in shovels which are widely used in applications where the part is carried up by the press slide after the press operation. The shovel is designed to move arms or a platform under the raised piecepart and catch it when knockouts or other means release the part from the raised die section. The shovel can then retract and

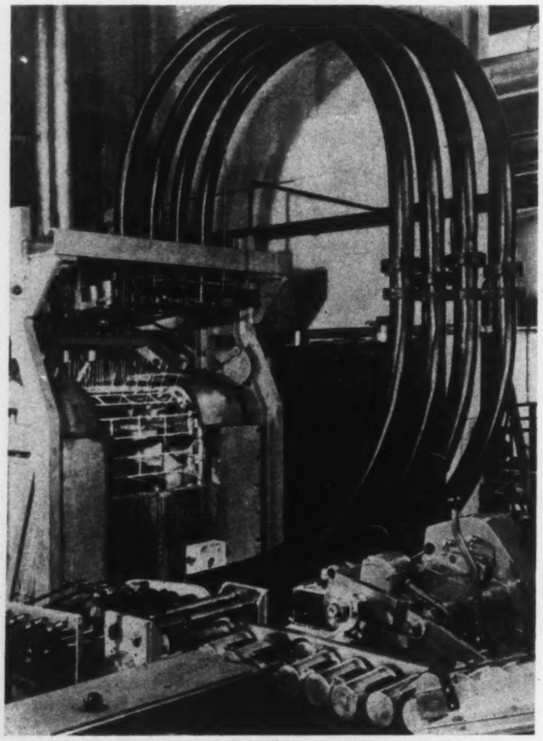

Fig. 25—Aluminum can bodies, trimmed to length and flanged in machine in foreground, are pneumatically conveyed through four plastic tubes to degreaser in background. Fingers push the can bodies into tubes, and air jets move the work through the tubes. This pneumatic handling arrangement was developed in conjunction with a manufacturing research project of Aluminium Ltd. of Canada.

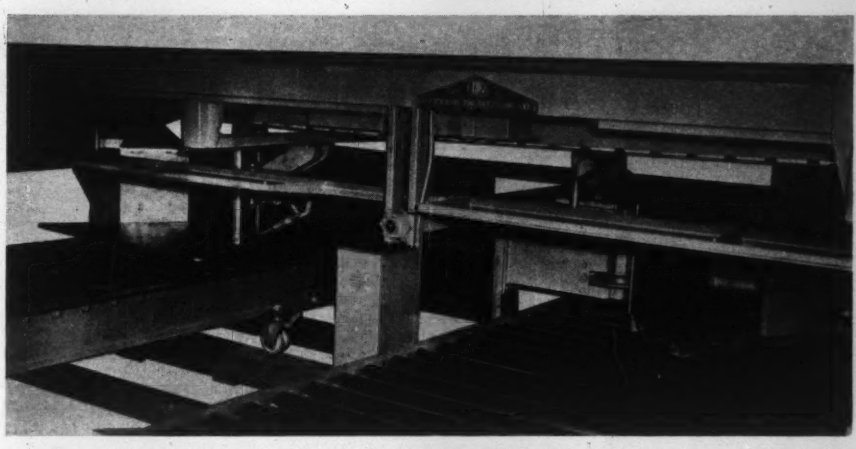

Fig. 26—Flat blanks or sheets, of odd shapes such as triangles, trapezoids, or parallelograms, can be alternately stacked in two piles by the machine shown. The sheets are carried into position on the underside of a belt backed up by electromagnets. Magnetic proximity switches detect proper positioning of sheet over pile and selectively de-energize the electromagnets. Unit is built by Bucciconi Engineering Co. Inc.

carry the part out of the press. Shovels also are built as independent units that can be moved from job to job.

Where a press being unloaded is one in a line of presses, provision for unloading that press may be combined with the loading arrangement for the succeeding press in a single piece of equipment. Several commercial variations are available for such combined functions. Custom designed and built units are also widely used.

Once the part has been moved out of the press, it can be moved away by a variety of chutes, conveyors, and other handling means. Belt conveyors are widely used, and when combined with magnetic elements can move steel parts positively up steep inclines. Even pipeline type arrangements have been used. In one such application, a continuous stack of motor laminations is mechanically pushed through a conveying "tube" formed by several longitudinal rods. In another application, *Fig.* 25, aluminum can bodies are pneumatically conveyed through tubes in a high speed can making line.

Where the integrated press unit ends with a stack of blanks or parts, various magazine loading and stack piling arrangements are used. Many of these are custom devices because of the requirements of the wide variety of parts involved. One standard unit, *Fig.* 26, which can stack odd shaped blanks alternately in two separate stacks, illustrates some of the possibilities in this area. In this unit, overhead electromagnetic elements support the blanks as they are advanced over the stacks. When the blank is in position over the chosen stack, the magnetic elements are selectively de-energized and the blank is dropped onto the stack.

▶ Pressworking Controls

In conjunction with suitable presses and handling equipment, a third major factor is required for automated press operations—pressworking controls. Elements and systems are necessary to control the actions in all pieces of equipment in an integrated line. Some of the pressworking controls now being applied will be discussed in the final part of this article in a subsequent issue.

are you stuck?

Since its inception AUTOMATION has helped increasingly in the solutions of hundreds of widely diversified practical problems in making manufacturing operations more automatic. Regardless of the character of the operation or system being developed, somewhere in industry a similar problem has been solved and, very often, equipment is available from reliable builders or suitable techniques are known to specialists.

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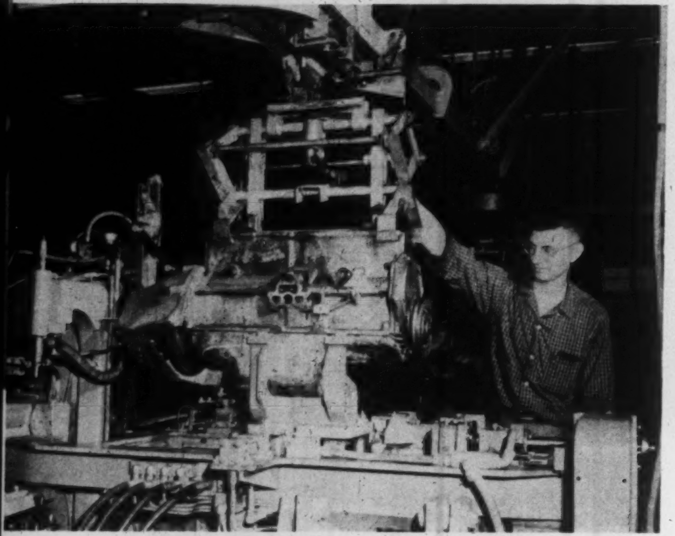
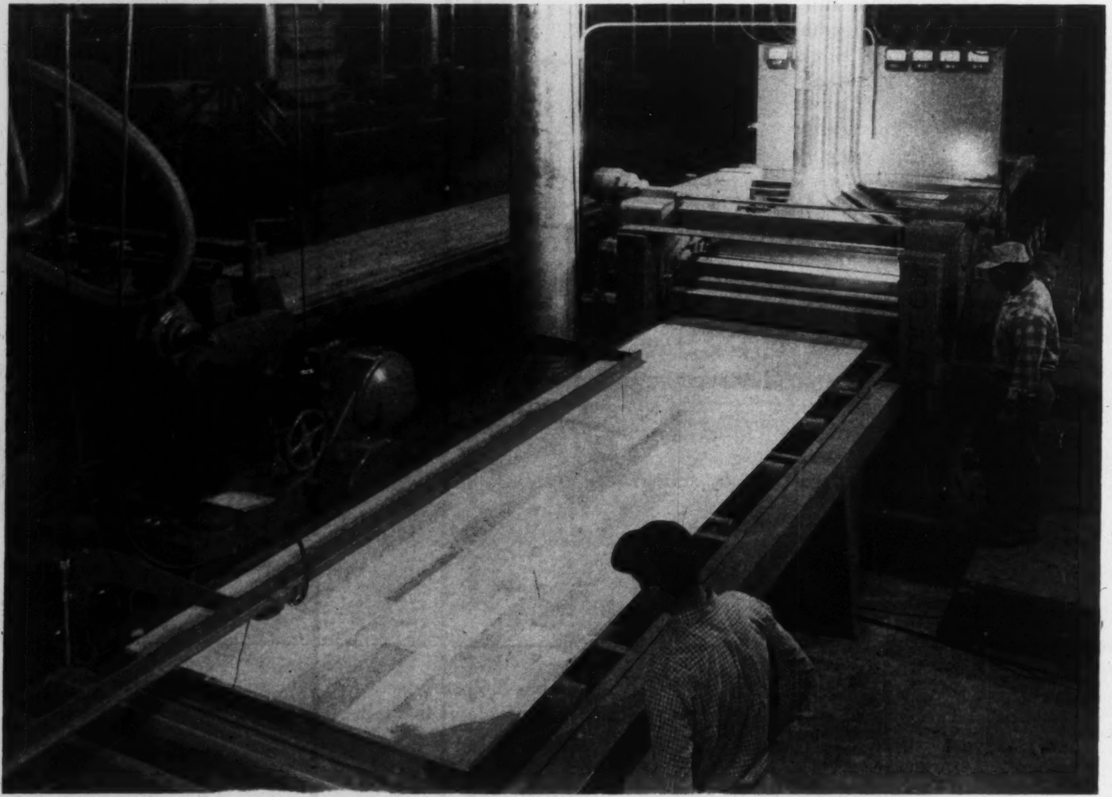


Self-Opening Tongs

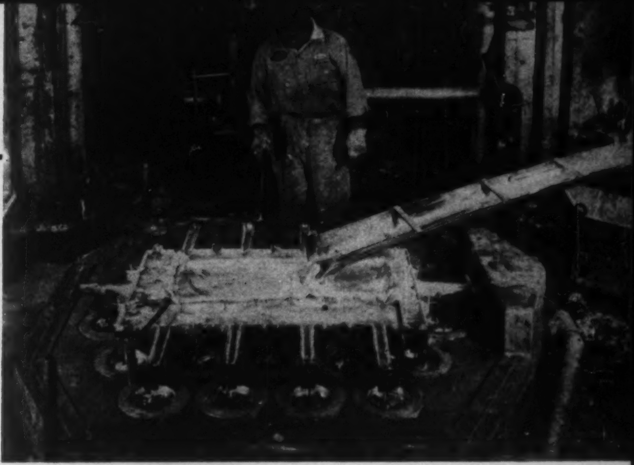
PARTIALLY-ASSEMBLED engine blocks are delivered to dynamic balancing machines by means of self-opening, self-closing tongs at the Trenton, Mich., Engine Plant of Chrysler Corp. When an engine block arrives at the balancing machine, an air operated cradle lifts the engine block upward, causing the jaws of the tongs to lock open and release the block for balancing. After the balancing operation is completed, the engine block is again lifted into the tongs, tripping a release mechanism and causing the jaws to close on the block. Seventy-five tongs are used in handling 6-cylinder engines, and another seventy-five tongs, slightly different in design, take care of 8-cylinder engine production. The tongs have a capacity of 500 pounds and were manufactured by Heppenstall Co.



Panel Sanding

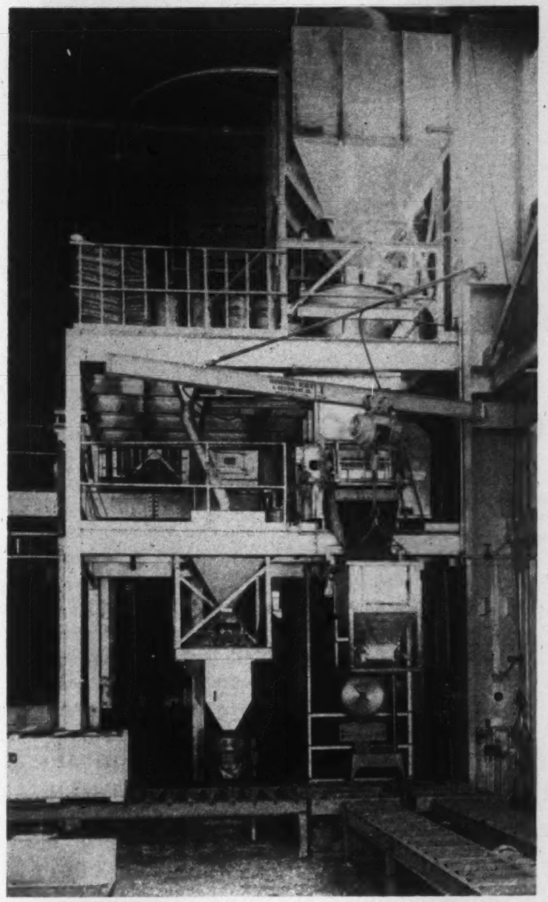
UPGRADING small pieces of lumber into extra-wide panels permits Edward Hines Lumber Co. to market kiln-dried stock at prices below those of ordinary shelving materials. The process involves the ripping of the lumber pieces to relatively narrow predetermined widths; cutting out knots and defects; end-joining and sizing the resultant strips on both edges; and then gluing the lengths together to obtain a large panel. Both sides of the panel are then simultaneously sanded in this eight-drum sander built by Solem Machine Co. The infeed of the sander (right background) is fed by an elevating table which is designed to keep the top panel of a pile in proper registration. When the panel emerges from the sander, it rides on idling rolls until the front end of the panel strikes a limit switch. This switch actuates a motor drive on the idling rolls which quickly carries the panel to a transfer mechanism. The panel is then transferred sidewise to a Greenlee Bros. & Co. double-end tenoner (parallel to the sander at the left) where finished edges are obtained in a ripping operation. Widths as great as 54 inches and lengths as long as 24 feet can be produced in the setup.

in action



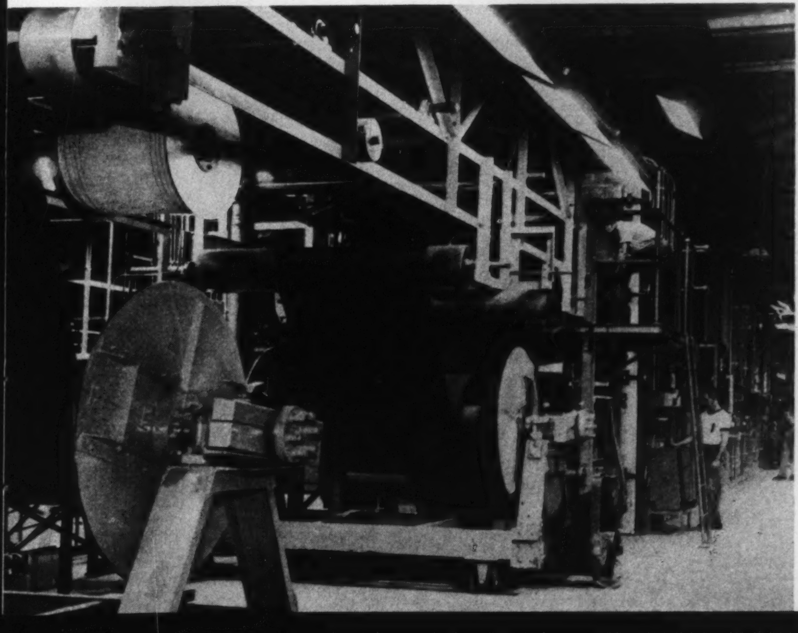
Billet Casting

EXISTING casting facilities at the Philadelphia plant of Michael Flynn Mfg. Co. were recently replaced with this Lobeck casting machine which produces twenty-two 6-inch diameter aluminum billets simultaneously. The machine features a special mold design and automatic metal flow control. Billets are cast in 20-foot lengths. A similar casting machine is under construction at a California plant of the same company. However, the new machine will simultaneously cast 24 billets of 6-inch diameters in 20-foot lengths and have an output of over 20,000 pounds of billets per hour. The casting machines were built by Lobeck Casting Processes Inc.



Mixing Foundry Sand

TOWERING nearly three stories high, this automatic weighing and proportioning system at Farrel-Birmingham Co. Inc. has helped increase production by assuring that core boxes and molds receive the proper mixture of foundry sand, activator, and oil binder. From top to bottom can be seen a 10-ton capacity hopper for sand (a 400-pound capacity hopper for iron oxide and a 100-pound capacity hopper for sodium perborate are hidden from view), a 15-cubic-foot conical weighing hopper, a Baker-Perkins mixer, a discharge chute from the mixer, and a suspended receiving bucket. A core box is on the roller conveyor to the left. The Richardson Scale Co. system is designed to weigh accumulatively 1000 pounds of sand and 15 pounds of iron oxide. To this mixture in the weighing hopper is added 50 to 500 grams of sodium perborate which is weighed on a separate scale. The mixture is then dumped into the mixer where a short mixing cycle occurs. After 15 seconds, oil is automatically introduced into the mixer, and a second mixing cycle occurs. Following this, the mixer automatically discharges into the receiving bucket. If the bucket is not in place, a special interlock actuates an audible alarm in a central control panel and the mixer will not discharge. The mixture is discharged from the receiving bucket into the core box under the manual control of an operator.



Drying Fibre

VULCANIZED fibre conditioner which imparts a high degree of formability and flexibility to vulcanized fibre is now in operation at the Norristown, Pa., plant of Taylor Fibre Co. Installed at a cost of approximately $250,000, the machine predries vulcanized fibre after it leaves a puring bath and before final drying in calendering rolls. It not only provides automatic and close control of temperature but also controls humidity. The conditioner has four ovens which dry the web on top and bottom and reduce its moisture content from approximately 60 per cent to 15 per cent in 250 feet of web travel. Predrying the fibre in the new equipment greatly lessens final drying time on the calendering rolls, thus increasing the company's drying capacity. Flexibility and formability of the vulcanized fibre—used in the manufacture of luggage, sporting goods, abrasive discs, safety masks, and tote boxes—are achieved by allowing the web to float through the machine on rollers rather than being pulled through under tension. The equipment was engineered by Frank W. Egan Co. and is part of a million dollar expansion and modernization program.

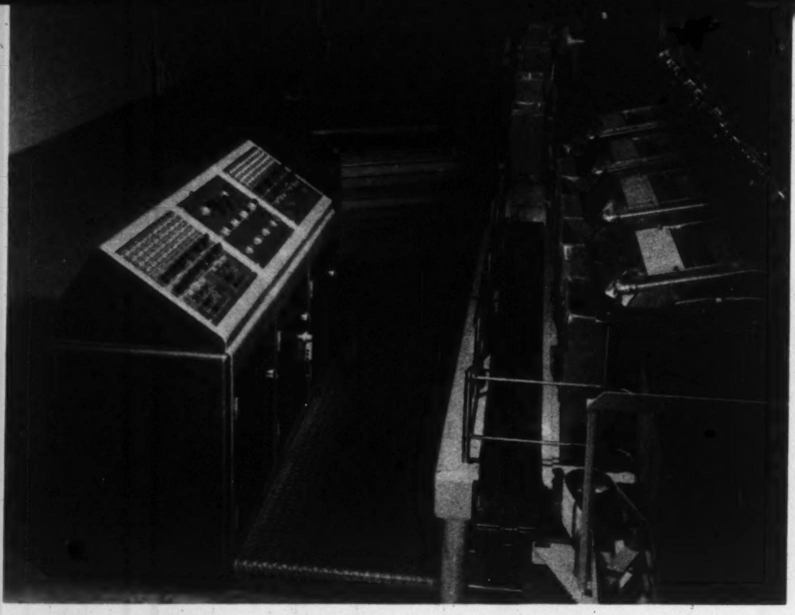


Fig. 1—Automatic capsule packaging machine has four filling heads that operate simultaneously to place predetermined quantities of capsules in cartons. Electronic controls ensure counting accuracy at average filling rate per head of 10,000 capsules per minute.

ELECTRONIC COUNTERS CONTROL

HIGH SPEED CAPSULE PACKAGING

Advances in one technology often create a need for similar progress in another. Full advantage of the capabilities of a high speed, multichannel feeding mechanism for dispensing capsules could not be realized until a comparatively sophisticated count control circuit was devised. A system that combines both elements in an automatic capsule packaging machine is described by the author.

By **S. H. McMILLAN**, Project Engineer, Strand Engineering Co., Ann Arbor, Mich.

PACKAGERS of small products such as nuts, bolts, tablets, and pills that are sold by quantity rather than weight have long been faced with the problem of maintaining accuracy in counting. A small percentage error in count—especially where quantities are large and unit values relatively high—can lead to substantial losses of profits for packagers or result in poor customer relations, depending upon whether the count is high or low.

Limitations of traditional industrial counting methods led R. P. Scherer Corp., a producer of gelatine capsules filled with vitamins and other pharmaceuticals, to seek a faster, more accurate way of counting products as they are packaged. An efficient counting method was needed since this company packages approximately 15 million capsules a shift, some of which sell for several cents each. The capsules are packed in cartons holding from 5000 to 50,000 units, depending upon the size and

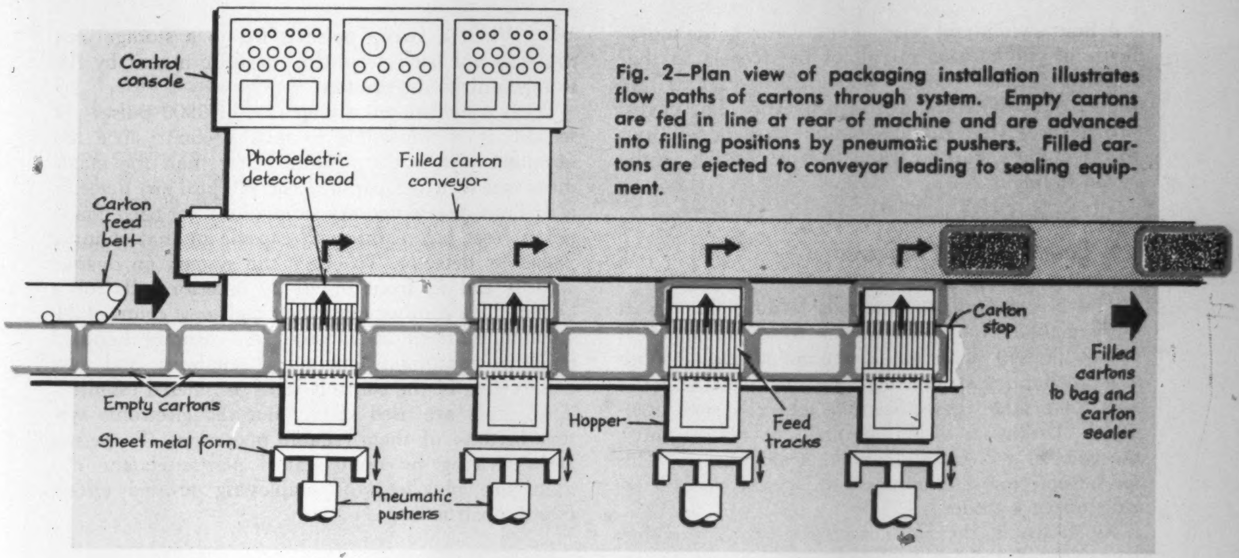


Fig. 2—Plan view of packaging installation illustrates flow paths of cartons through system. Empty cartons are fed in line at rear of machine and are advanced into filling positions by pneumatic pushers. Filled cartons are ejected to conveyor leading to sealing equipment.

shape of the product.

To meet the requirements of the capsule counting and packaging operation, Strand Engineering Co. designed and built an automatic system, *Fig.* 1, using mechanical components provided by Scherer Corp. General layout of the automatic capsule counting and packaging system is shown in the plan view of the installation, *Fig.* 2. Cartons, with their top flaps held open by the folded ends of plastic bags, are fed in a solid line along the rear of the machine. A conveyor operates continuously to feed the line of cartons against a stop at the end of the machine.

Four capsule feeders are mounted above the carton supply conveyor. The last feeder is centered over the carton that is restrained by the stop, and the other feeders are equally spaced two carton widths apart. Thus, each feeder is above a carton, with a carton width between.

Supply of empty cartons to the feeders is effected by a series of pneumatic pushers. There is one pusher for each feeder. When a pusher is actuated, a sheet metal piece is advanced so that the carton immediately under a feeder is moved to the filling position. The width of the sheet metal piece is equal to the width of a carton, and in the advanced position the sheet metal piece occupies the space of the carton that was fed. This prevents longitudinal motion of the line of cartons during the carton feeding cycle and permits withdrawal of the pusher. When a pusher is fully retracted, the empty cartons close to form a solid line along the rear of the machine. If a carton is in the filling position when a pusher advances another carton, the filled carton will be pushed onto a conveyor that carries the filled carton to bag and carton sealing equipment.

Each capsule feeder includes a hopper and a track section containing 24 parallel, sloping channels. Capsules flow from the hopper into the track section by gravity. They are then conducted along the channels by vibratory action until they drop into cartons placed in the filling position. Each feeder has two operating modes to provide a normal and a trickle feed rate. In this application, the average feed rate of each feeder is 10,000 capsules per minute.

▶ Machine Cycle

Each feeder operates independently of the others in accordance with signals from a control console. To program a feeder, an operator sets its two banks of selector switches on the panel. A lower bank of switches is set to the total number of capsules to be loaded into each carton by the feeder; an upper bank is set to a slightly smaller number.

As the capsules leave the feeder, and drop into a carton, their passage is detected by a bank of photoelectric cells. There is one cell for each channel of the feeder. Electrical signals from the 24 cells are fed to the control console where they are processed electronically to register one count per capsule on a decade counter. When the number of capsules fed into the carton equals the number set on the upper bank of selector switches, the feed rate of the feeder is automatically decreased to a trickle. A few seconds later, when the total count reaches the figure set on the lower bank of selector switches, the feeder is stopped and the following events occur in rapid succession: 1. The pneumatic pusher for the feeder moves an empty carton from the carton supply line into loading position beneath the feeder. The empty carton simultaneously pushes the filled carton onto the conveyor leading to the sealing area. 2. The electronic counting circuit in the control console is reset. 3. The feeder starts to fill the empty carton. The cycle is repeated automatically until the operator pushes a stop button on the control console.

A limit switch and relay circuit controls the movements of the cartons for all of the feeders so that collisions cannot occur when filled cartons are ejected onto the filled carton conveyor. The circuit also ensures that the pneumatic pushers will not operate unless empty cartons are in position in the carton supply line.

▶ Count Control Circuits

The use of multiple channels feeding capsules at random intervals introduced a control problem that is not present with single-channel feeders. With a multichannel arrangement, two or more capsules may pass their respective detector cells simultaneously. Unless provision is made to the contrary, the counter will count them as a single unit. This source of error is eliminated by special control circuits for each feeder.

As shown in the block diagram, *Fig.* 3, the electrical impulses from the detector cells are not fed directly to the decade counter. Instead, each detector is connected to a separate, temporary storage unit within the console. The temporary storage units employ transistors in flip-flop circuits. Each time a capsule passes a detector cell, the impulse from the cell activates, or "sets," the associated storage unit to show that a capsule has passed.

The count control circuit in the console also includes an electronic clock generator and commutator. The clock generator pulses at a rate of 3000 pulses per second, and the commutator distributes the pulses sequentially to each of the temporary storage units. Action is that of scanning, or inspecting the state of each flip-flop circuit. When a sweep pulse enters a storage unit that has been activated by the passing of a capsule, a pulse is transmitted from that storage unit to the counter, registering a unit count. At the same time, the activated storage unit is reset so that it is ready to receive another impulse from its associated detector cell. When a sweep pulse is fed to a storage unit that has not been activated, no pulse is sent by the storage unit to the counter.

With a continuous sweep rate of 3000 pulses per second, it is impossible to miss a count since the sampling rate is many times faster than the maximum rate at which capsules can fall past any detector cell. Thus, the temporary storage unit for each channel is reset before the next capsule in that channel passes its detector. To check the system, an opaque card is slid in front of all 24 detector cells for a feeder. The counter must then register a count of 24.

Since millions of capsules are usually handled daily in continuous operation, reliability and ease of servicing of the controls were considered essential. Transistors are used throughout the electronic system because of their reliable operation. To permit fast servicing by nontechnical personnel, the circuits are plug-in type employing printed circuit board construction.

▶ Broad Utility

The principles of electronic counting and control used in this equipment can be applied in other systems where it is necessary to keep a running count of independent events, or to effect control actions based on such counts. With the circuits described, average counting rates as high as 2000 counts per minute are obtained easily for any single channel or individual series of events. Thus, the system is suitable for control of high volume production processes using equipment such as printing presses or packaging machines.

Although photoelectric cells are used as detectors in the application described, other types of sensing devices—magnetic, electrostatic, pressure, etc.—can be employed for this purpose. The equipment can be arranged to operate signals or alarms, or to initiate control actions, at the end of predetermined total counts.

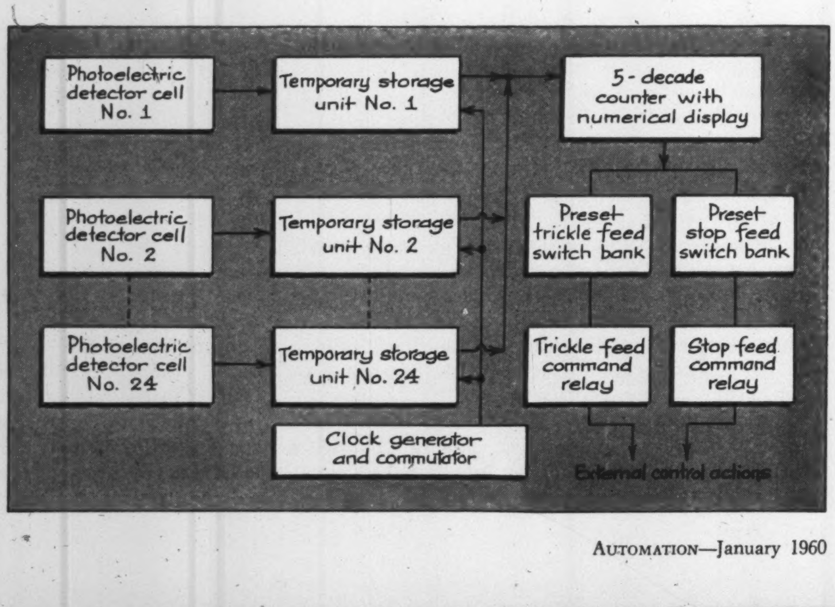

Photoelectric detector cell No. 1
Temporary storage unit No. 1
5-decade counter with numerical display
Photoelectric detector cell No. 2
Temporary storage unit No. 2
Preset trickle feed switch bank
Preset stop feed switch bank
Photoelectric detector cell No. 24
Temporary storage unit No. 24
Trickle feed command relay
Stop feed command relay
Clock generator and commutator
External control actions

Fig. 3 — Block diagram of count control circuit for one feeder illustrates major components used. Photoelectric cells sense passage of capsules from each of 24 feeder channels and activate individual temporary storage units. Clock generator and commutator continuously scans contents of storage units and releases total count information to decade counter. External control actions occur when counter total corresponds to numbers preset on switch banks. Circuit was devised to permit accurate counting of simultaneous events.

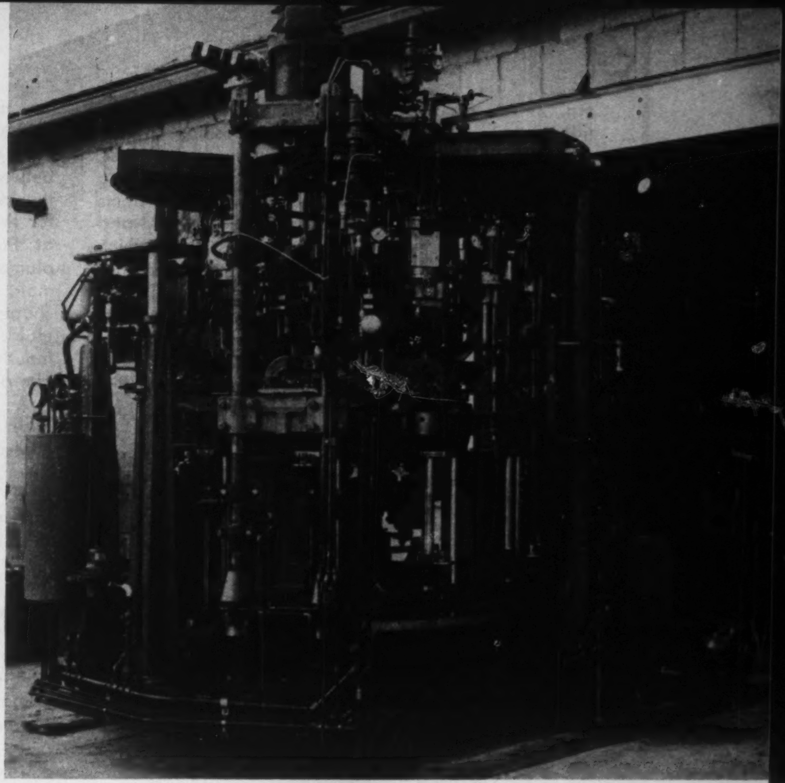


Fig. 1—This glass container forming machine of the press and blow type is designated the Knox J-K machine. Completed equipment coming off the assembly floor of a Knox shop is ready for installation in a glass making plant. This is a 10-station rotary index machine built on a 40-inch diameter Geneva-motion index plate housed in the base frame.

MOLDING GLASS CONTAINERS

Successful marketing in highly competitive industries requires efficient manufacturing facilities geared to the customer's needs. Such a requirement led this manufacturer to develop his own rotary indexing machine to provide automatic output of large quantities with flexibility of product mix. Special design features make possible the production of lightweight glassware without sacrificing strength.

By HAROLD A. YOUKERS, Director of Engineering, Knox Glass Inc., Knox, Pa

MARKETING trends in the container industry over the years have led to procedures whereby container manufacturers generally manufacture and warehouse the containers they supply and deliver these to their customers on an "as used" basis. This means a minimum of inventory for the packers and a need for extensive warehousing and production flexibility for the container manufacturers. Manufacturers of glass containers are no exception to this rule.

The desire to efficiently meet the requirements of the market has led Knox Glass Inc. to establish manufacturing facilities strategically in the areas

Fig. 2—The accompanying elevation views are partial sections that show the relative positions of the J-K machine elements for each of the numbered positions identified in the schematic plan view shown to the right. In the elevation section views, the items not colored are parts of the rotating index table and represent one of the ten identical workstations which are indexed around the center column. The machine elements shaded are the stationary frame, column, cam plates, and workstation devices that do not go around with the indexing table.

At a height of about nine feet above the floor a gob feeder intermittently drops gobs of molten glass into a tubular drop chute that delivers them into the cavities of the blank molds, *Fig. 3*.

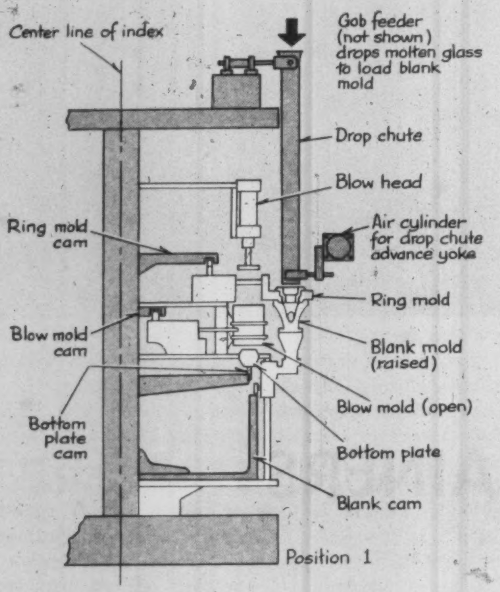
The gob feeder is between Positions 1 & 2. The drop chute pivots to charge the molds as they move between these positions. As the index is completed the drop chute returns to loading position ready for the next charge, and the press head air cylinder at Position 2 is actuated, lowering the pressing plunger through the ring mold and into the blank mold cavity. This plunger forces the gob into the shape of the cavities in the ring mold and the blank mold. The threads or lip on the outside of the jar's mouth are formed in the ring mold at this position. The plunger is retracted and the index motion begins.

As the mold indexes from Position 2 to 3 the blank mold is lowered away from the ring mold and the conical blank of molten glass is left suspended from the ring mold. The ring mold cam slides the blank back into the open blow mold at Position 3. The bottom plate cam causes the bottom plate to rise into molding position.

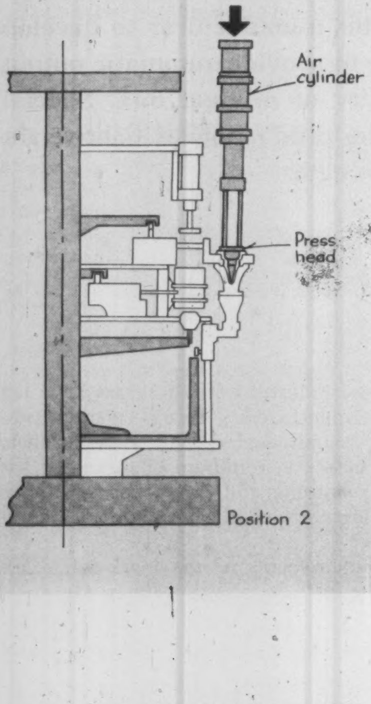
As the mold indexes from Position 3 to 4 the blow mold cam closes that mold, and the air cylinder above the blow head lowers the blow head onto the ring mold. The blow cycle commences. The molten blank is blown out to conform to the shape of the cavity of the blow mold, and the blow cycle continues through Position 5 and 6, then ends at Position 7.

As the mold indexes from Position 7 to 8 the blow head is retracted, the blow mold opened, the bottom plate lowered, and the ring mold slid out again away from the blow mold. Now an air cylinder inside the ring mold holder is actuated and the ring mold opened, releasing the finished glass container onto the take-away conveyor.

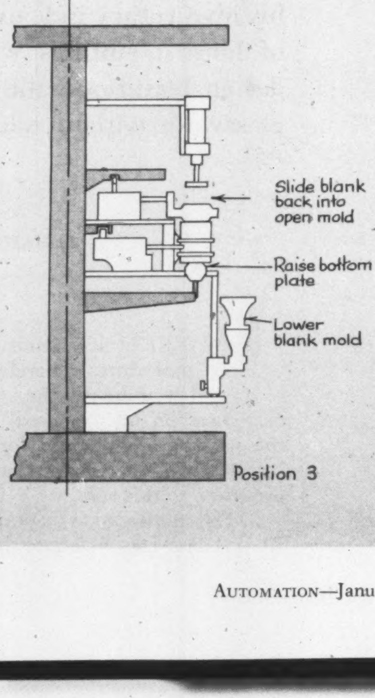
As the mold indexes through the next two positions the ring mold is again closed. The blank mold is raised into contact with the ring mold. The mold station is now ready for another gob to be dropped into the blank mold as it indexes from Position 1 to 2. The cycle repeats.


Center line of index
Gob feeder (not shown) drops molten glass to load blank mold
Drop chute
Blow head
Air cylinder for drop chute advance yoke
Ring mold cam
Ring mold
Blow mold cam
Blank mold (raised)
Blow mold (open)
Bottom plate cam
Bottom plate
Blank cam

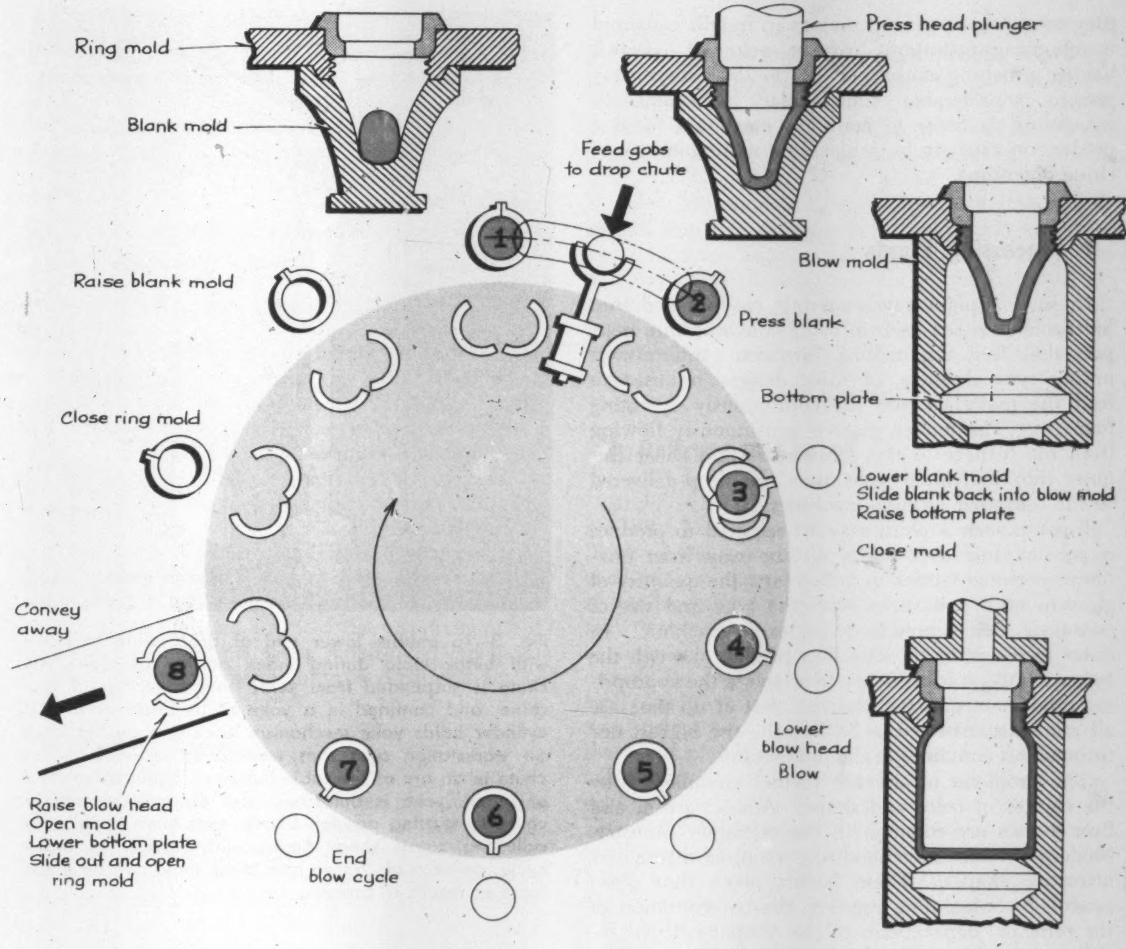
Position 1

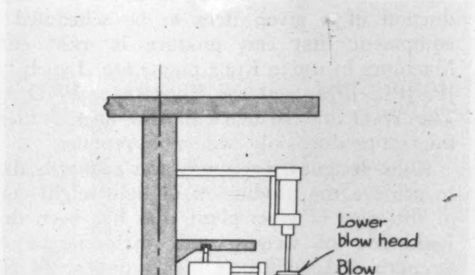

Air cylinder
Press head

Position 2

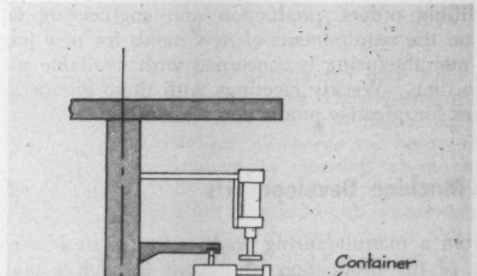

Slide blank back into open mold
Raise bottom plate
Lower blank mold

Position 3


Ring mold
Blank mold
Press head plunger
Feed gobs to drop chute
Raise blank mold
1
2
Press blank
Blow mold
Bottom plate
Close ring mold
3
Lower blank mold
Slide blank back into blow mold
Raise bottom plate
Close mold
Convey away
8
4
Lower blow head
Blow
5
7
6
Raise blow head
Open mold
Lower bottom plate
Slide out and open ring mold
End blow cycle


Lower blow head
Blow

Positions 4·5·6·7


Container
Convey away

Position 8

they are to serve, so that savings in freight costs and warehousing operations can be achieved. Plants having a melting capacity of 125 to 250 tons per day present considerable complexities in production scheduling in order to maintain maximum furnace production capacity by achieving a minimum of machine downtime.

▶ Processing Plants

In such a plant raw materials are weighed into batches and mixed prior to being conveyed into hoppers that feed the melting furnaces. Intermittent pusher type chargers, of Knox design, are used to feed the materials into the continuously operating furnaces. The molten glass is continuously flowing from the furnace to the gob feeders that shear this glass into individual gobs that are drop-delivered to the container forming machines.

Because such a plant may be required to produce a product mix that varies all the way from one-ounce perfume bottles to gallon jars, the quantity of glass in each gob varies with the type and size of container being produced on each machine. In order to maintain capacity flow of glass through the furnace tanks it is necessary to schedule the appropriate product mix in the plant so that at no time are all machines expected to be forming the biggest nor the smallest container in the product line.

The problems of size are further complicated by the choices of color and shape. Amber, green, and flint glasses are common in the container industry. Modern product merchandising requires distinctive, attractive shapes. These factors mean that plant production scheduling requires the co-ordination of the principal departments of the company, if the facilities are to be utilized in the production of glass and not idle for unnecessary changing of molds. Sales product divisions help decide on the priority for filling orders, production and engineering advise on the requirements of new molds for new jobs, and manufacturing is concerned with available machine time. Weekly meetings with these groups are a must for effective production scheduling.

▶ Machine Developments

From a manufacturing engineering point of view none of the production equipment in such a plant can be considered as an independent entity, but must be analyzed on the basis of its relationship to the over-all plant processes. Developments in manufacturing facilities have included automatic batch weighing and mixing equipment; automatic control of furnace charging, firing, and glass level within the tanks; continuous recording of temperatures in the tanks and forehearths; semiautomatic decorating facilities; and automatic handling into, and control of, annealing lehrs.

Although automatic operation is important to the success of the plant, flexibility for quick change of product is of prime concern, especially with respect to the container forming equipment. Each of the company's plants is equipped with more than one type of container forming machine to enable production of a given item to be scheduled on the equipment that can produce it most efficiently. Machines in use in Knox plants are: Lynch types 10, JP, JPL, JPM; and the Knox types W-D and J-K. The W-D and 10 make narrow neck bottles, while the rest produce only wide mold products.

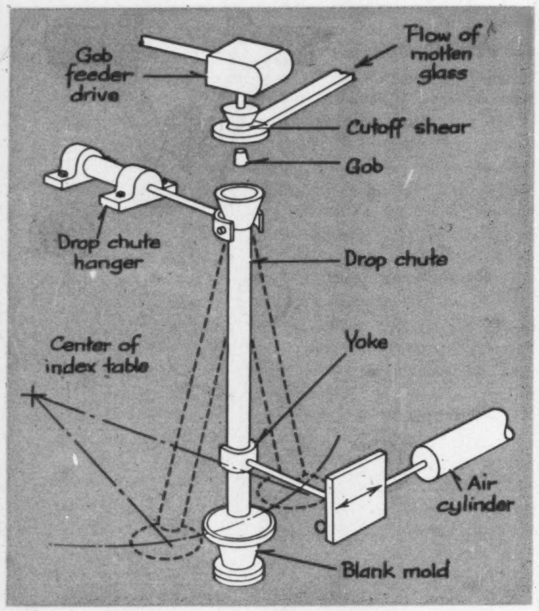


Fig. 3—To enable lower end of drop chute to move with blank mold during index portion of cycle, the chute is suspended from pivot hanger at top of machine, and confined in a yoke at its lower end. Air cylinder holds yoke mechanism against a pusher latch on workstation such that workstation actually moves chute in an arc as the table indexes. Upon completion of index, yoke is unlatched and air cylinder returns chute to starting position above next blank mold. By adjusting cutoff shear timing with respect to index cycle, delivery of charge into blank mold can be timed for best results in process.

Knox-designed machinery was primarily developed to achieve the production of lightweight containers in the type of glass plant that has been described. Reduction of weight with maintenance of high strength and quality is highly desirable. Shipping costs are reduced for both the container manufacturer who transports the empty glassware, and for the processor who ships the filled containers to market.

The key to making lightweight ware is to get uniform distribution of the glass in the mold. If wall thickness varies in an individual piece, the glass must be heavier than necessary if the thinnest part is to be as thick as the minimum allowable. When molds and machines are specifically designed for achieving even distribution of glass in the mold, they can be operated at higher speeds and still produce high quality products. Weight reductions of 10 to 15 per cent can be achieved.

One type of automatic glass container production can be described by the use of the Knox J-K machine as an example, *Fig.* 1. Many concepts of design familiar in the glassmaking and packaging industries are incorporated in this machine. Many of the major components are standard Lynch JP parts. Over-all design work done by the Machine Div. of the Knox Glass Engineering Dept. combines the long standing technology of the trade with experience and ideas for improvement to do a specific type of container forming job.

The process used is called "press and blow" because the molten gob of glass is first pressed by a plunger into a blank mold and then blown by air pressure into finished shape in a blow mold. The machine uses a rotary index table to move the work in process from one position to the next, *Fig.* 2. Some of the workstation devices go around with the table. Others are stationary, being activated during the dwell portion of the index cycle. Actuation is accomplished by cams and air cylinders. The machine can be equipped with either single or dual cavity molds and therefore produces either one or two containers each time it indexes. The drive motor is attached to a variable speed drive so that production speed can be adjusted to meet the requirements of the particular container being molded. A top speed of about 40 indexes per minute is experienced.

▶ Molding Accuracy

One of the special features that enables the equipment to make lightweight glassware is the manner in which the mold components are aligned. The ring mold has a tapered seat on its underside. A matching taper is machined into the top of the blank mold and the top of the blow mold. When mold parts come together during the machine cycle these tapers assure concentricity of the mating parts. Adequate pilots are provided on the press head plunger and the finish ring mold so that the cavity produced by the plunger will be concentric with the blank mold. If these mold parts were to be loosely piloted and improperly mated the wall thickness produced in the press operation would not be uniform. This nonuniformity would carry over into the blow operation and the resultant container would have a thin side that would be vulnerable to breakage. Because this process finishes both the inside and outside of the mouth of the jar in the press operation, the taper seat design of the blow mold top assures concentricity of finished top and finished sides of jars, a quality difficult to obtain without such a mold design.

▶ Delivery of Charge

Another unique feature of the machine is the method of charging the blank mold so that the delivery of the gob can be timed to suit the molding conditions of the particular container being formed. If the drop chute were fixed on both top and bottom and remained stationary on the machine, it would be necessary to drop the gob into the blank mold during the dwell portion of the index cycle. Under such conditions the gob would have to be in the mold before the start of the index motion that brings the blank mold under the press head. To have a hot gob under the press head it is advantageous to achieve late delivery of the gob into the blank mold. This is accomplished on the J-K machine by causing the lower end of the drop chute to move with the blank mold during the index portion of the cycle, *Fig.* 3, and providing adjustment of gob cutoff timing relative to index motion, *Fig.* 4.

With this arrangement the operator can, while the machine is running, set the cutoff shears to drop the

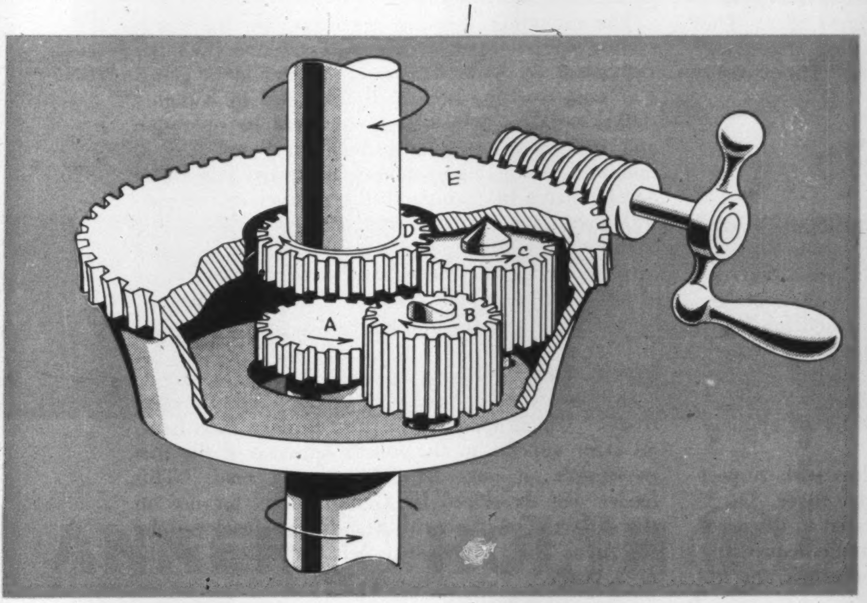


Fig. 4—Differential gear train design is used to adjust timing of cutoff shears in gob feeder so that delivery of charge can be adjusted relative to indexing of machine. Shaft *A* comes from main drive box. Shaft *D* goes to gob feeder shears. Worm is fastened to an external handwheel and is engaged with the worm wheel on the outside of pinion carrier *E*. Pinion carrier has one pair each of gears *B* and *C*. These are placed angularly in the carrier such that each gear *B* is engaged with one of the gears *C*. Gear *A* engages gears *B*. Gears *C* engage gear *D*. Assume counterclockwise rotation of *A*. This drives *B* clockwise, thus driving *C* counterclockwise, and *D* clockwise. If the worm crank is turned such that *E* moves counterclockwise, *D* will be retarded relative to its former position. When *E* moves clockwise, *D* will be advanced.

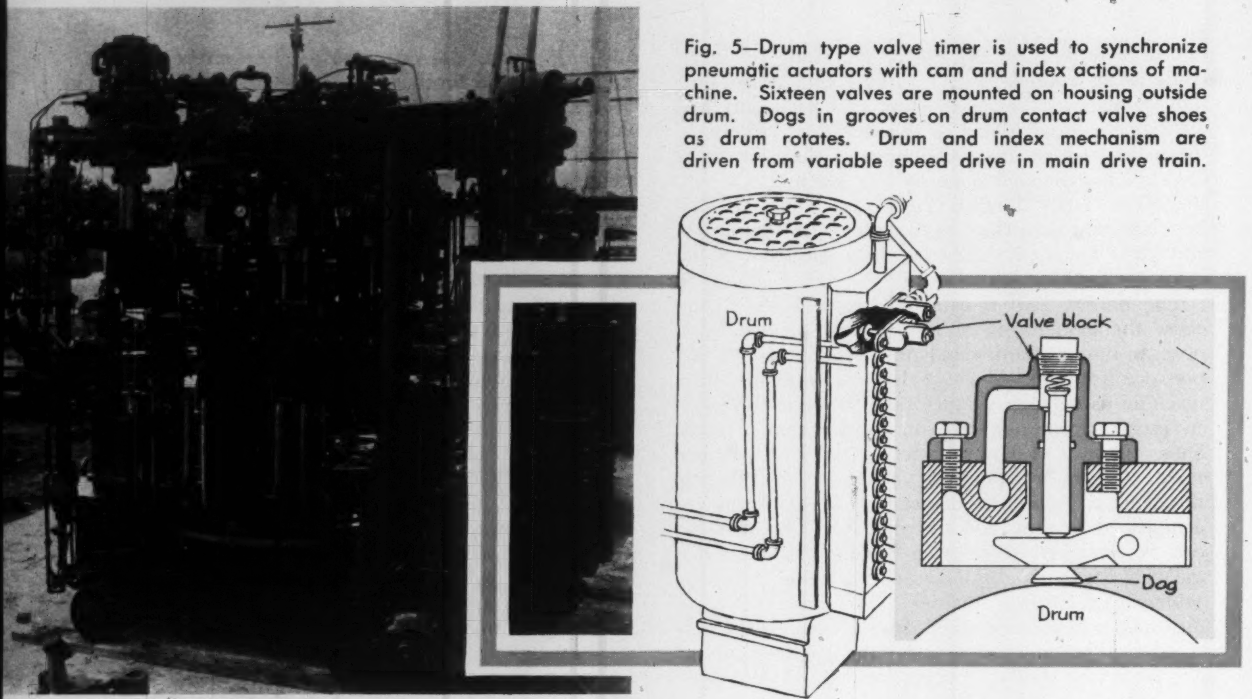


Fig. 5—Drum type valve timer is used to synchronize pneumatic actuators with cam and index actions of machine. Sixteen valves are mounted on housing outside drum. Dogs in grooves on drum contact valve shoes as drum rotates. Drum and index mechanism are driven from variable speed drive in main drive train.

gob during the advance of the index and at such an instant as to give the best molding conditions. If the machine must be temporarily shut down, the drive to the gob feeder is kept running and the rest of the machine is clutched out of operation. The gobs are shunted out to the side and later remelted as cullet. When operation is commenced again the gob feeder and the index cycle may be retimed to be in desired phase. Operation of such machinery requires auxiliary services to maintain continuous production. Compressed air is used not only to power the pneumatic cylinders and supply the blow heads, but also to cool the molds. Automatic lubrication is provided in the form of a twelve-head oiler. The molds are spray lubricated with either a graphite solution or a silicone-graphite mixture. The plunger in the press head is water cooled.

▶ Control of Actions

Machinery of this nature lends itself particularly well to cam operation. Stationary cams or cam segments mounted to the frame engage cam follower rollers on the mold station elements as they are indexed around the machine. This method of actuation is supplemented by air cylinder actuators where an action must be initiated during a portion of the dwell period on the index cycle, or where a sustained holding force is more easily obtained by air cylinder techniques.

In order to program the air devices with respect to the index actions a drum type valve timer, *Fig.* 5, is used. With the drum rotation geared to the drive train, there is no chance of pneumatic sequencing getting out of time with respect to the machine index. Because of the absence of electrical actuating circuits on these machines, sensors that act as safety interlocks on the travel of various mechanisms are air valves in the pneumatic circuits rather than snap-acting switches that might be encountered in other types of machinery.

Completed containers are released onto a take-away conveyor that moves them to a lehr-loading station where automatic armstackers pick them from the conveyor and place them on the broad wire belt that takes them through the annealing cycle. After they are annealed the containers are inspected and placed in boxes for storage and shipment.

The container forming machines are automatic cycling equipment producing glass containers that are untouched by hand. However, it should be noted that each machine is carefully attended by a highly skilled operator who closely observes its operation and makes whatever adjustments are required to maintain production of quality glassware. As newer developments in manufacturing equipment are conceived and put into operation, it is quite likely that the operators attending the machines will be called upon to have even greater knowledge of the workings of the machinery and of the art of forming glass.

CORRECTION

In the article entitled "Magazine Feed for Electrodes," which appeared in the February 1958 issue, an error appears in the fourth sentence of the first paragraph on page 94. This should read: "This feeder was developed by Genarco, Inc. for use on the AN/AVQ-3 Airborne Searchlight developed by the Arma Div., American Bosch Arma Corp. for the U. S. Navy."

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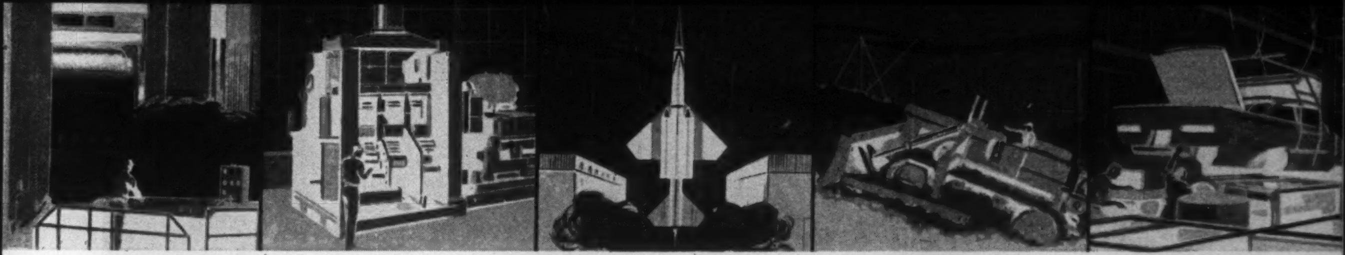

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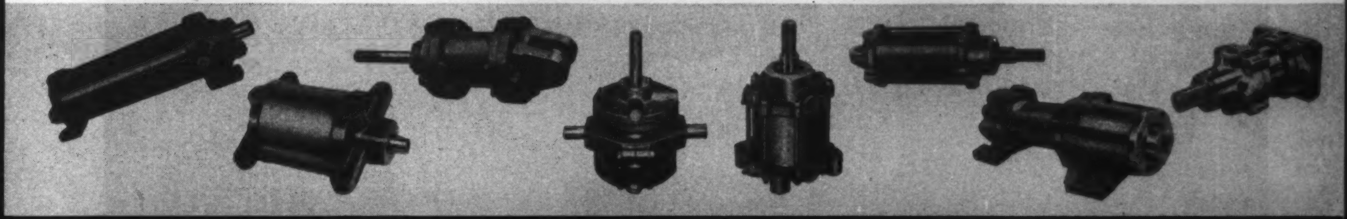

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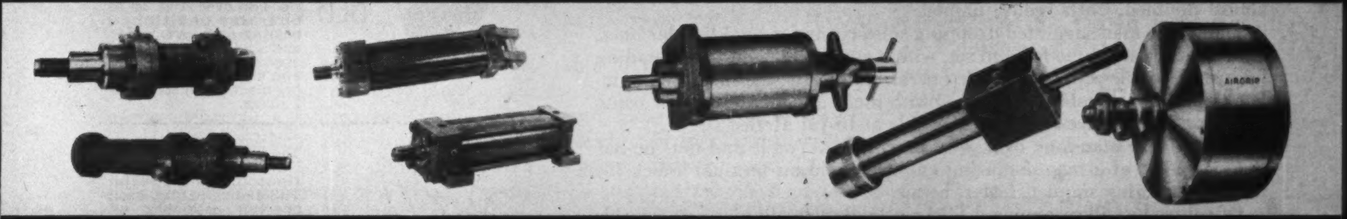

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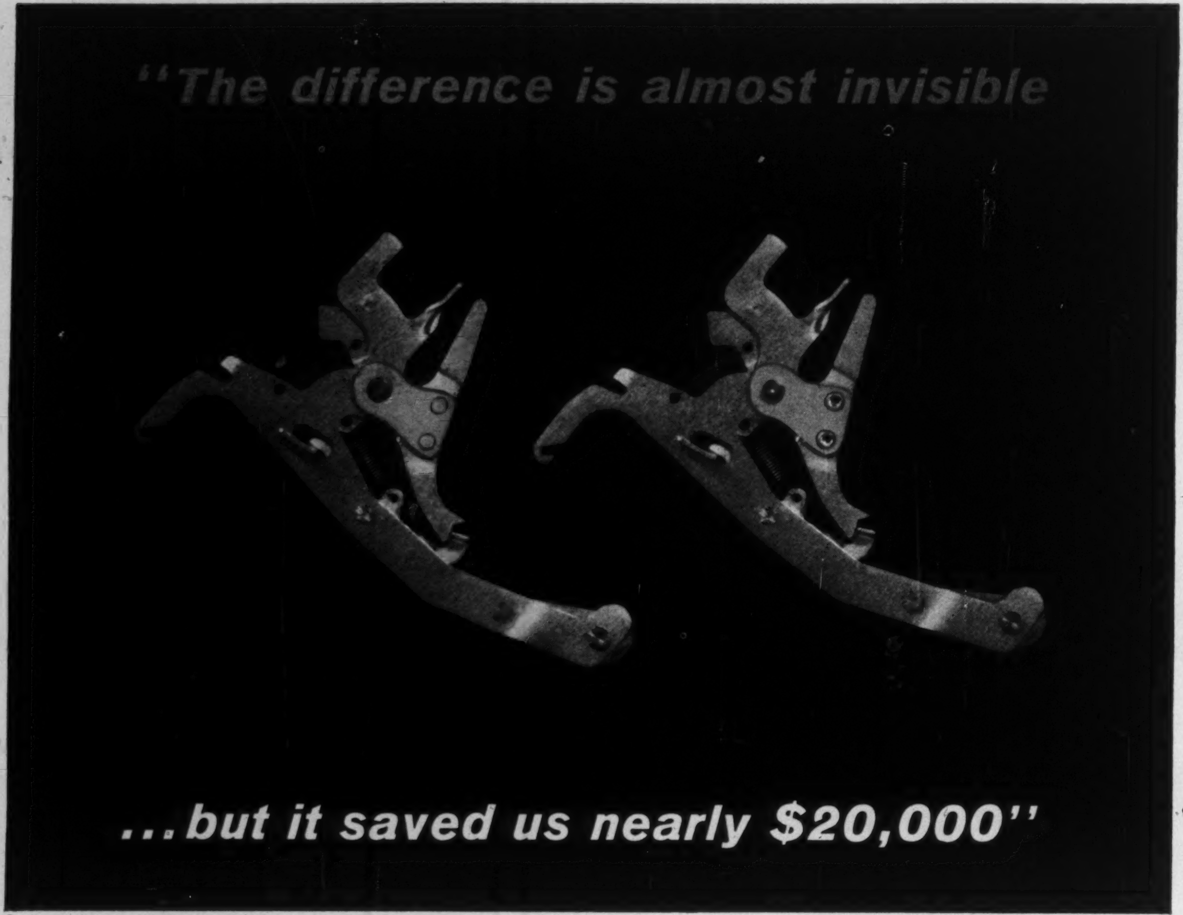
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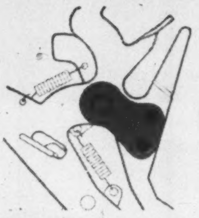
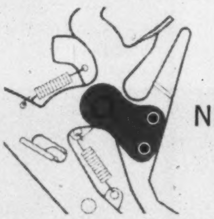


OLD

Two operators assembled 2 solid rivets and 1 shouldered stud into countersunk holes of trip pawl, placed this on a tray, then placed carrier arm over stud. Third operator positioned bearing plate over rivets and stud, lifted the loose assembly from the tray and slid it under a staking machine to stake the 2 rivets.



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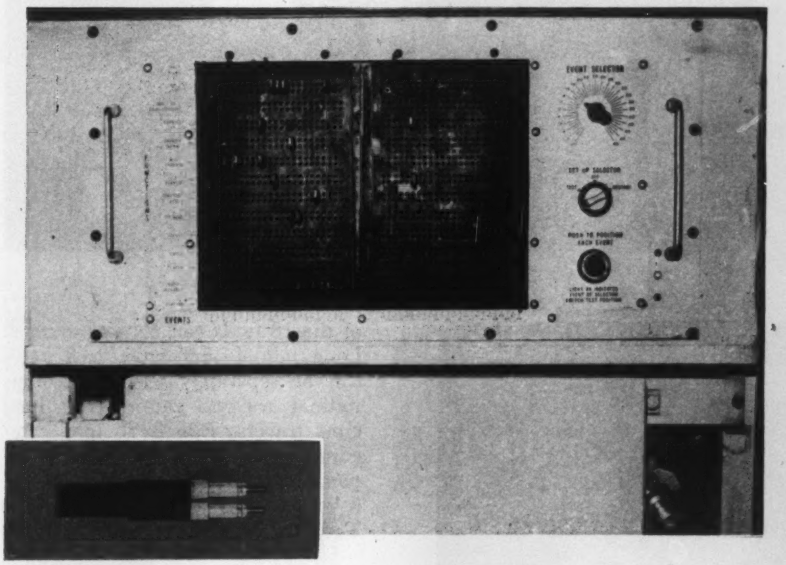
Machines and plant equipment for more automatic operations.
For detailed information and literature, use card Page 19.



Program is set up on plugboard by inserting plugs in proper sequence opposite desired machine function. A plug (inset) is inserted in the panel for each event in the cycle. A stepping switch scans the board and initiates actions indicated by plugs.

Plugboard Programs Milling Machine

DESIGNATED Telematic, plugboard system controls all functions or movement of a milling machine, also has provisions for auxiliary operations such as fixture clamping or indexing. The control was developed by **Cincinnati Milling Machine Co.**, Cincinnati, Ohio, and designed for use with company's Hypowermatic machine. For each machine function there is a horizontal double row of plug holes. Program is set up by inserting plugs in proper sequence in holes opposite the desired function. Trip dogs, positioned on the machine table and spindle carrier, initiate each new action and the control board directs the action.

Machine functions that can be programmed are: Table right or left, table or carrier rapid traverse, spindle carrier up or down, constant feed for accurate stop, dwell, quill advance, tracer control, spindle rotation, fixture control, and reset. A stepping switch scans the control board one step at a time and initiates all functions indicated by the placement of plugs. When the switch finds a plug in *Reset,* it automatically returns to its initial point, ready to start a new cycle. Standard version of the plugboard control provides for 24 steps or events. Unit shown provides 48 steps.

For setting up, a selector switch is provided to position the machine elements to any selected point in the cycle. A pushbutton then initiates the next action without waiting for the trip dog to function. During the operation, if an operator wants to determine where the machine is in its cycle, he can turn the selector switch and the panel light will come on when the active event is reached. The operator can also stop the machine at any part of the cycle and resume the cycle without returning to the beginning of the cycle.

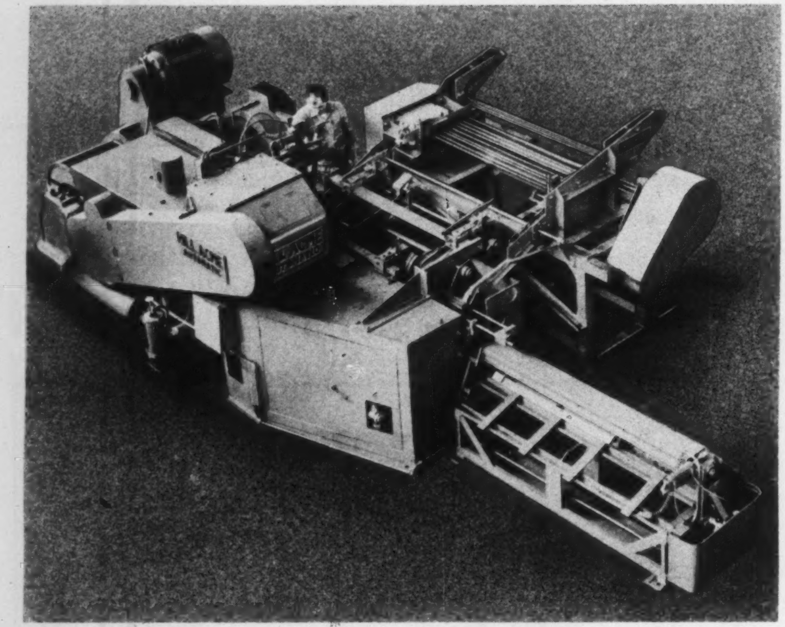
When one event must be followed very closely by a second event, the trip dog for the second event is set in a different T-slot and will actuate the event, even though the first event trip dog is still partially depressing its plunger. No trip dog is activated unless its function is plugged in the control board for that particular event in the cycle.

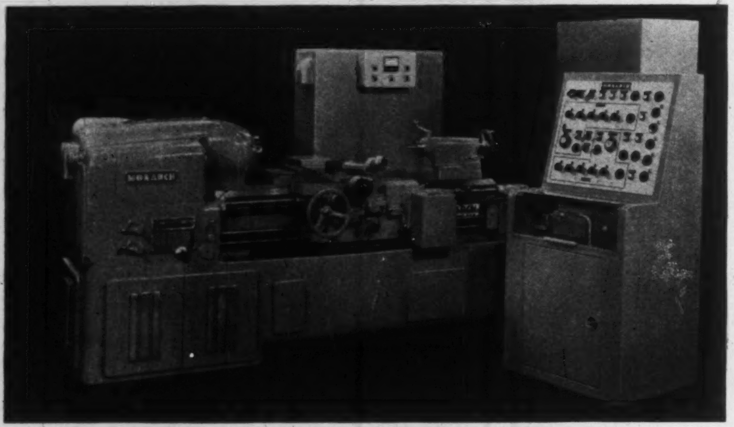
Circle 401 on Page 19

Forging Machine With Integral Heater

Automatic forging machine, integrated with an induction heater, can perform 4-stage forging operation on ends of rods in lengths from 12 to 72 inches. Mine roof bolts ⅝ and ¾ inch in diameter have been run at a rate of 45 pieces per minute in sustained operation. Pieces longer than 36 inches are supported by a walking beam through the various passes. In operation, the rods are loaded into the feeding rack where an index feed (chain driven) positions them for proper spacing through the induction furnace. As the rod ends are heated they are delivered, at the proper timing cycle, to the forging machine by a roller chain feed where they are gaged for length, picked up by fingers and passed progressively through the 4-position die. The finished forgings are discharged from the back of the machine by means of a separately driven conveyor that is arranged for both right and left hand discharge. Machines are available in capacities from 1¼ to 5 inches. **Hill Acme Co.**, 1201 W. 65th St., Cleveland 2, Ohio.

Circle 402 on Page 19





Numerically Controlled Lathe

Turning, facing, and boring operations are numerically controlled by means of a console located near the lathe. Data input is from standard 8 channel, 1-inch wide punched paper tape. A programmer sets up information which is punched on the tape in block form. Each block directs the dimension the carriage must move from the zero point, as well as the diameter information for movement of the cross slide. When the tape is read on the tape reader in the control console, the information is interpreted in the director cabinet and remains in memory until the proper carriage and cross slide positions are obtained.

Feedback units on the carriage and cross slide signal the director when the command position has been reached.

Tape commands can select any of four infinitely variable speed ranges for the spindle. The main drive motor gives speeds from 20 to 2000 rpm. Electronically powered feed motors drive the carriage and cross slide through gear boxes. Each gear box has a low and high feed range, and a traverse range (all can be tape selected). Within each one of the high or low feed ranges there are 9 preselectable feed rates ranging from 0.55 to 6.25 ipm in low; and from 2 to 25 ipm in high. Any of the 18 feeds can be programmed. Longitudinal and cross feed rates can be separately selected. Longitudinal traverse rate is 150 ipm; cross traverse rate is 75 ipm. Accuracy obtained by the control system, on both diameter and length, is ±0.001-inch. **Monarch Machine Tool Co.**, Sidney, Ohio.

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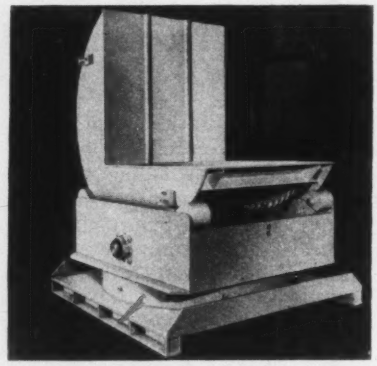
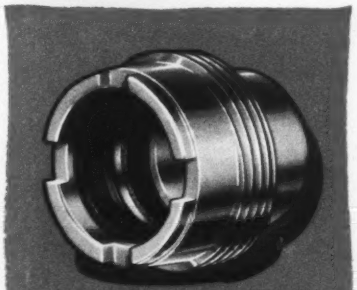


Turnover Cradle

Where coiled materials are used, 20,000 lb capacity turnover cradle automatically rotates and palletizes rolls. A coil is placed vertically on the cradle against a pallet by a fork lift truck. Then in one operation, the cradle rotates 180 degrees horizontally and 90 degrees verti-

Circle 678 on Page 19 for Fittings→
Circle 679 on Page 19 for Cylinders→

PARKER-HANNIFIN FLUID-SYSTEM COMPONENTS



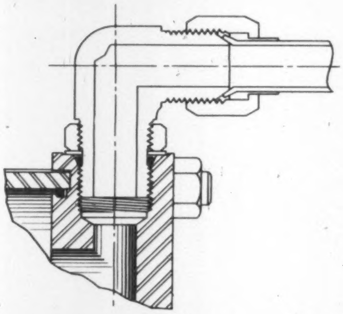
Bronze cartridge gland with "LIPSEAL"® and "WIPERSEAL" can be easily replaced without dismantling cylinder.

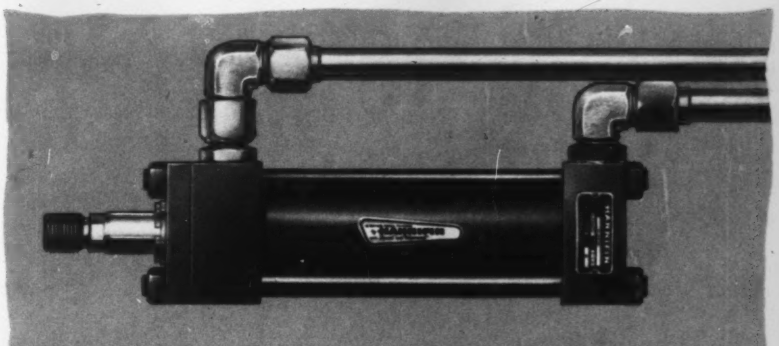
Drip-free rods, leak-proof ports...

get both with

HANNIFIN

hydraulic cylinders





Specify straight thread O-ring bosses on your Hannifin high-pressure hydraulic cylinders for leak-proof connections at no extra charge. These port connections, together with Hannifin's drip-free rod seals, provide the answer to all your cylinder sealing problems.

Select either "Step-Seal" piston rings (standard) for most applications or exclusive "LIPSEALS" where zero "clearance flow" is required.

For absolutely leak-proof connections under all operating and installation conditions, get Hannifin hydraulic cylinders with S.A.E. straight-thread ports. There's no extra cost. And because a straight-thread fitting is tightened *after* alignment, not aligned by "backing off," sealing is positive even when the cylinder must be mounted in tight quarters.

Straight-thread ports, plus the removable-replaceable cartridge gland that seals Hannifin cylinder rods drip-free, keep machines, floor and product free of hydraulic oil.

Other Hannifin cylinder features include ground and polished rods induction-hardened to an extra-deep case, then hard-chrome plated and polished again; cylinder walls that are "Tru-Bored" straight and perfectly round *before* being honed . . . PLUS 48-hour shipment in emergencies on standard Hannifin cylinders.

Your nearest Hannifin sales office or representative is listed in the A-Z volume of Thomas' Register. Call us in when cylinders figure in your designs. Or, for cylinder literature, write:

HANNIFIN COMPANY

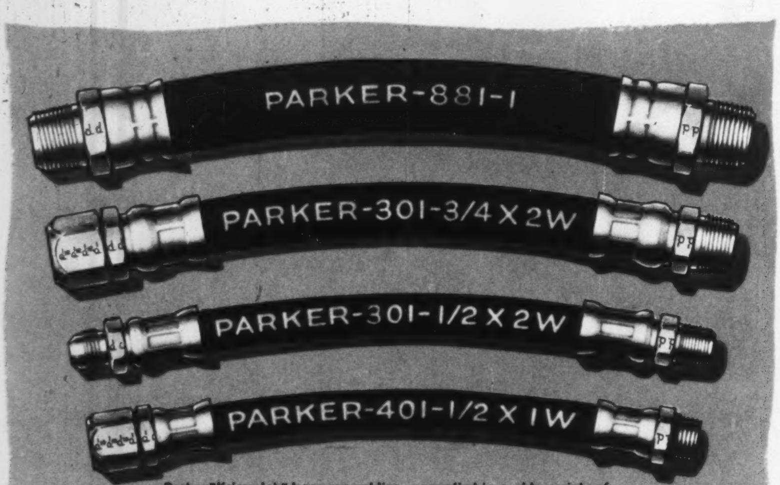
515 South Wolf Road • Des Plaines, Illinois

A DIVISION OF PARKER-HANNIFIN CORPORATION

PARKER-HANNIFIN FLUID-SYSTEM COMPONENTS

Now from Parker

BOTH permanent-end and re-usable hose assemblies



Parker "Krimp-lok" hose assemblies — supplied in a wide variety of fittings-and-hose combinations for any type of service and fluid.

A few of the wide range of Parker adapters available.

You may require permanent-end hose assemblies for your production AND re-usable fittings with coils of hose for quick, trouble-proof replacements in the field. With the addition of Parker's new "Krimp-lok" fittings, permanent-end assemblies are now available from Parker. They use the same Parker hoses that enjoy a wide acceptance when used with Parker *no-skive* "Hoze-lok" fittings in the replacement field.

A full range of Parker adapters is also available.

Ask your Parker Hose Distributor, listed in the Yellow Pages, for engineering advice and literature on "Hoze-lok" re-usable fittings, also Parker hose and adapters. Write us in Cleveland regarding your requirements for Parker "Krimp-lok" Hose Assemblies.

Parker

FITTINGS AND HOSE

DIVISION

17325 Euclid Avenue

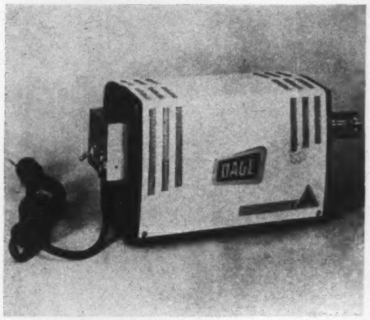
Cleveland 12, Ohio

PARKER-301-1X2W
PARKER-841-SIZE 8
PARKER-401-1/2 X1W
PARKER-201-13/32 X1W

Parker "Hoze-lok" no-skive hose fittings and Parker hose, the ideal combination for short-run production and quick, reliable field replacement.

A DIVISION OF PARKER-HANNIFIN CORPORATION cally. This motion palletizes the coil and rotates it so that after it is palletized, it faces the fork lift truck, ready for removal. **La Deau Mfg. Co.,** 2702 San Fernando Rd., Los Angeles 65, Calif.

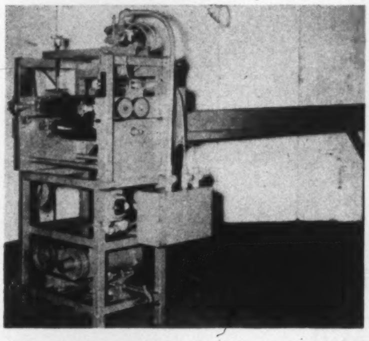
Circle 404 on Page 19



TV Camera

Feature of automatic closed-circuit TV camera is a transistorized video amplifier which provides 600-line resolution. Electronic circuits automatically make instantaneous adjustments to variations in light levels. Other features include: Controls on chassis to regulate horizontal and vertical size, linearity, and centering; and adjustments for beam and black level. Model 70-A will operate on 45 w, 115 v, 60 cycles. **Dage Television Div., Thompson Ramo Wooldridge Inc.,** Michigan City, Ind.

Circle 405 on Page 19



Roller Coater

Equipment applies partial coating in a predetermined location on any flat surface. Unit combines an electric eye, a limit switch control, and variable timer to apply the coating in the spot desired. The coater is supplied with roller lengths from 12 to 108 inches. In an application where contact adhesives are put on plastic materials, the sheets are conveyor-fed into the machine through a set of nip rolls located on the infeed side. Individual stops on the nip rolls regulate the feed speed.

The variable timer allows the sheets to pass through the coater to a predetermined position, at which point a signal is sent to an overhead air cylinder holding the coating roll assembly up. The coating roll then lowers and applies the adhesive to the sheets. A second variable timer lifts the coating roll when the desired amount of adhesive has been applied. The timers can be set for various lengths or set to give skip coatings of various patterns to the product. **Union Tool Corp.,** Warsaw, Ind.

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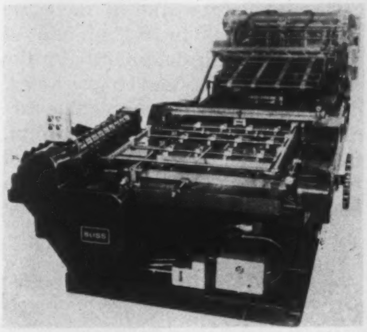
←Circle 678 on Page 19 for Fittings
←Circle 679 on Page 19 for Cyliinders



Duplex Slitter

Equipment can process either lithographed or plain 44 by 44-inch sheets. Model 5325, available as a squaring or body blank slitter, consists of two units mounted on a common base and driven in unison. The first table retracts, providing sample room for setup and for grinding the cutters on the second slitter. Both slitters have feed out rolls and the first slitter has back up rolls on it to prevent deflection and assure delivery of the strips to the second slitter table. The first set of slitter knives has an air actuated sheet stop that prevents sheets from getting into the cutters until advanced by the feed bar. The second operation slitter is protected by a shear pin and limit switch in its feed chain drive to stop the machine if an overload should occur. Double sheets are prevented by a detector and stop located ahead of the second slitter cutter shafts. Rotating magnets, working in conjunction with a mechanical hold down mechanism, provide positive separation and pick up of the strips by the fingers on the feed chain. **Container Machinery Div., E. W. Bliss Co.,** 1375 Raff Rd., S. W., Canton, Ohio.

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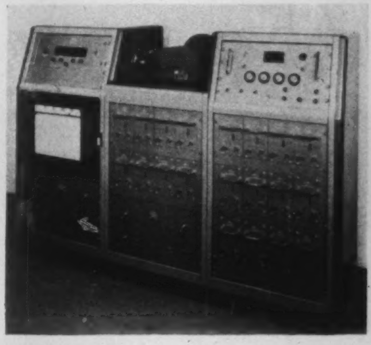


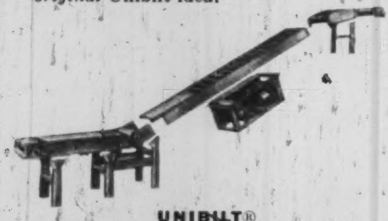
Tube Tester

Instrument is designed for the automatic testing of vacuum tubes on a production basis. With appropriate input modifications, it can be used for any recording of data where input variable in the form of EMF's in the 0 to 10 mv range are available. The system can sequentially select up to 200 input variables and digitally record each variable with 3-digit point identification via a motorized tape punch. The data is recorded in an 8-channel code which can be used with an IBM tape-to-card converter. Cycle time per data point is 1 second; maximum time per recording cycle is 15 minutes. Accuracy of the system is ±0.5 per cent of full scale. A feature of the system is that it will digitally display the variable value in a lamp bank. The point is identified by digital indication of selector position in the selector module. Any standard measurement potentiometer strip chart recorder can be used. The chart will advance during readout cycles, giving an analog curve of the input values for each cycle. The recording cycle can be initiated automatically or manually by a digital clock. **Datex Corp.,** 1307 S. Myrtle Ave., Monrovia, Calif.

Circle 408 on Page 19

WHAT MAKES ONE CONVEYOR MORE ECONOMICAL THAN ANOTHER?

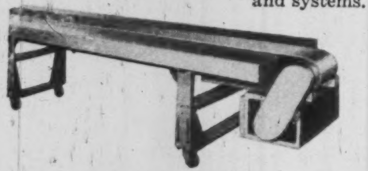
Standardized unit design that makes it easy to assemble your own systems and alter them at low cost when your requirements change. This is the *original* Unibilt idea.



UNIBILT®
Build-It-Yourself Construction

WHAT MAKES ONE CONVEYOR MORE DEPENDABLE THAN ANOTHER?

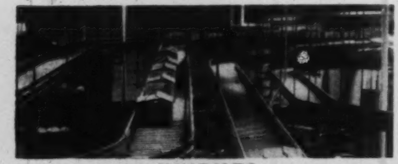
Highest quality materials and components designed and selected to *work together*. The staff at Conveyor Specialty Company has over 35 years experience in engineering conveyors and systems.



UNIBILT®
"Unitable" Belt Conveyor

WHAT MAKES ONE CONVEYOR SYSTEM MORE EFFICIENT THAN ANOTHER?

Pre-engineered design, tried and proven in thousands of installations over years of operation. Cost-conscious companies the country over have placed confidence in Conveyor Specialty.



UNIBILT®
Conveyor system

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CONVEYOR SPECIALTY CO.
INCORPORATED
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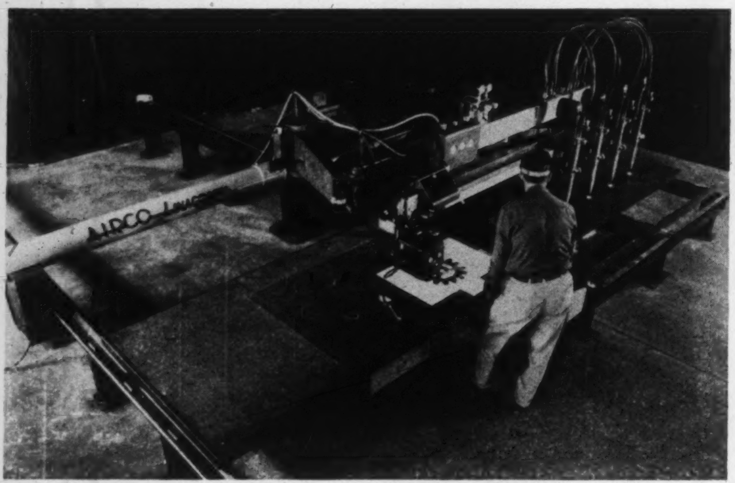
Circle 680 on Page 19



Metal Shape Cutting Machine

Medium duty shape cutting machine is equipped to carry a maximum of four motorized torches for use with acetylene, propane, or natural gas. The unit is capable of shape cutting and straight line cutting anywhere within a rectangle bounded by a 96-inch width and an indefinite length determined by the number of rails and tracks used. Equipment includes the machine carriage, torches, control mechanism, tracing table, and twenty feet of running track. The tracing area has a movable template-top, 8 feet by 4 feet.

Feature of the unit, designated Linagraph, is that it has a centralized operator control. All controls for gas pressure, the motorized torches, the machine carriage, and the tracing device are located above the mobile tracing table, within reach of the operator. Unit can be set up for either left-hand or right-hand operation and can be equipped with manual, magnetic, or electronic type tracing units. **Air Reducton Co. Inc.**, 150 E. 42nd St., New York 17, N. Y.

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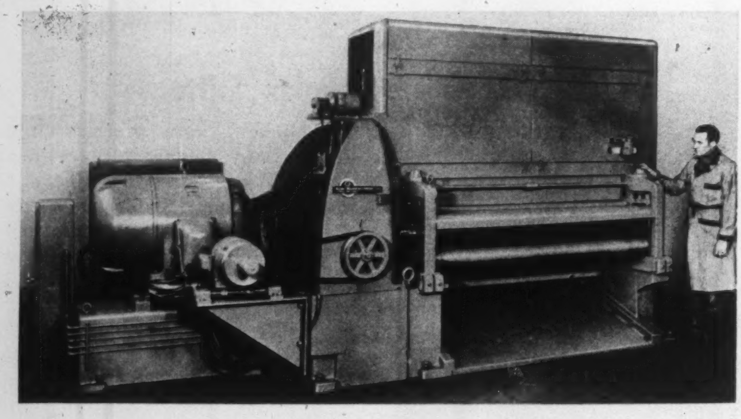
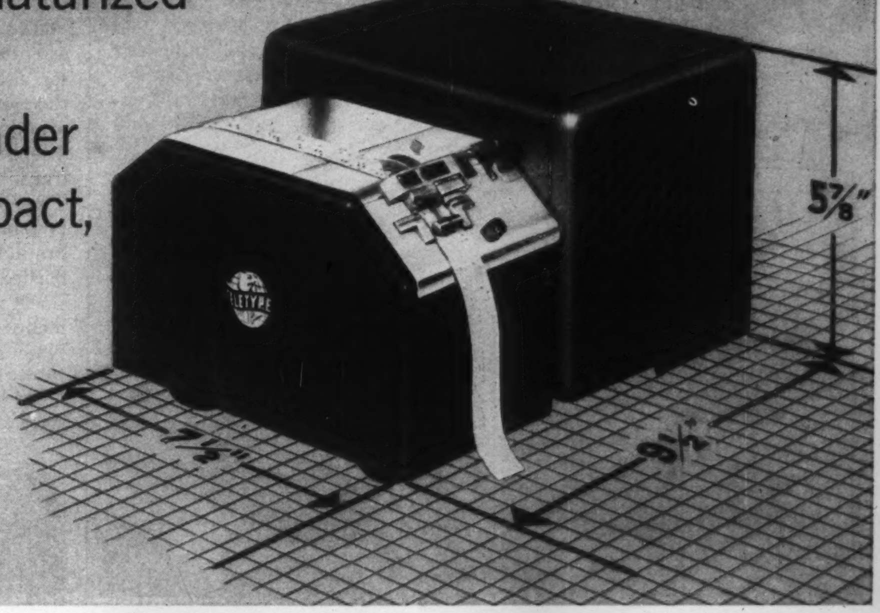


Continuous Sheet Polishing Mill

Sheet polishing mill can perform abrasive belt-finishing operations on metal sheets, plate, and coil stock at feeds from 20 to 60 fpm. Mill has four main operating components—an idler roll, a contact roll, a billy roll, and pinch rolls. An abrasive belt is supported by the contact and idler rolls. The contact roll is driven by the main drive motor through a V-belt drive. An air cylinder raises and lowers the

40% reduction in size and weight . . .

New miniaturized Teletype Tape Reader has compact, space-saving design



Here is a new tape reader set from Teletype Corporation—the Model 28 miniaturized LXD. It features a 40% reduction in size and weight. This new space-saver set is completely compatible with other Teletype communications equipment. It features facilities for sequential (serial) transmission, with optional contacts available for multi-wire output, and it is designed to read either chadless or fully perforated tape.

The Model 28 miniaturized LXD tape reader is made, as is all Teletype equipment, for round-the-clock, day-in, day-out service with minimum maintenance. The unit is equipped with an all-metal clutch that requires lubrication only once or twice a year, and operates with precision accuracy for continuous or intermittent transmission.

New Brochure **A 4-page brochure on the new Teletype miniaturized LXD tape reader is available upon request. Write to Teletype Corporation, Dept. 25A, 4100 Fullerton Ave., Chicago 39, Ill.**

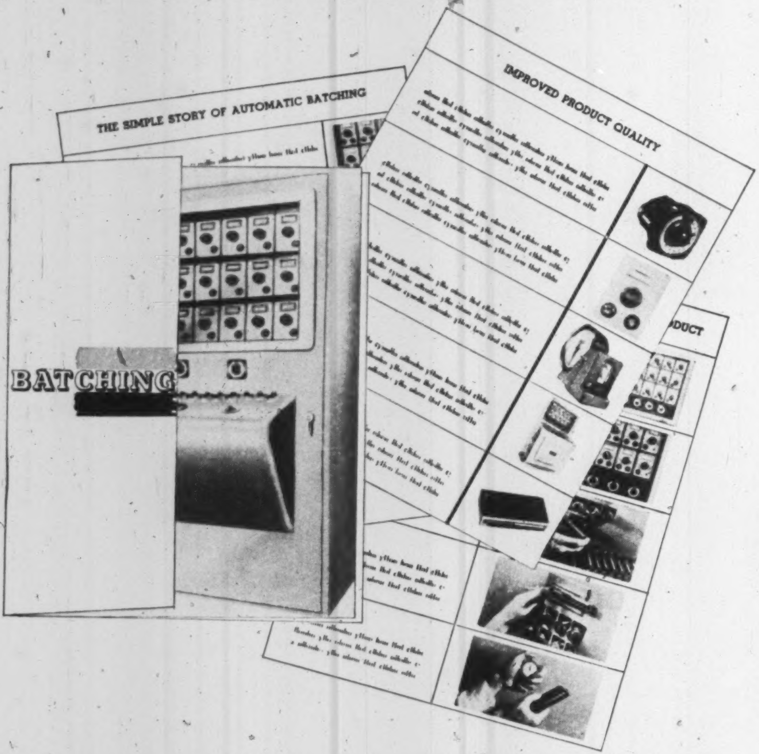
Specifications

Speed:	100 WPM (gears available for slower speeds)
Tape levels:	5 or 6
Dimensions:	5⅞" H, 7½" W, 9½" D.
Weight:	Approx. 15 lbs. net
Motor:	Synchronous, 115 V., 60 Cy.
Finishes:	Gray-green or custom

TAPE READER SET

TELETYPE®
CORPORATION
SUBSIDIARY OF *Western Electric Company* INC.

AUTOMATIC
BATCHING
HANDBOOK


THE SIMPLE STORY OF AUTOMATIC BATCHING
IMPROVED PRODUCT QUALITY
BATCHING

EVERYTHING YOU NEED TO KNOW ABOUT AUTOMATIC BATCHING

- HOW TO DO IT
- HOW MUCH IT COSTS
- WHAT YOU NEED
- HOW TO USE WHAT YOU HAVE
- HOW TO SELECT THE RIGHT SYSTEM

If you are now combining two or more ingredients in any kind of formula or batch, write now for this new free automatic batching handbook. It describes in detail how automatic batching works, how to convert existing plant facilities or plan new plants for automatic operation. It illustrates the latest batching systems available, lets you select the right type for your particular needs. Also shows you how to combine materials handling equipment, storage facilities, and weighing equipment for greatest economy, increased production. This is the newest, most complete handbook on automatic batching available—be sure to write for your free copy today!

HOWE
THE HOWE SCALE CO. • RUTLAND, VT.
A SUBSIDIARY OF SAFETY INDUSTRIES, INC.

Circle 682 on Page 19

idler roll assembly to maintain belt tension. Oscillation and tracking of the belt occurs by pivoting the idler roll with an air cylinder mechanism that is controlled by an externally mounted electric eye.

In operation, the sheet or plate material to be finished is traversed through the mill between the contact and billy roll by individual assemblies of four pinch rolls, one set ahead of and the other behind the contact roll. The pinch rolls are driven in either direction by a separate motor through worm gear transmissions and flexible couplings. The billy roll provides the work pressure; is adjusted by air or hydraulic cylinders to obtain the needed pressures. Unit can handle stock widths of 30, 40, 54, or 74-inches. **Acme Mfg. Co.,** 1400 E. Nine Mile Rd., Detroit 20, Mich.

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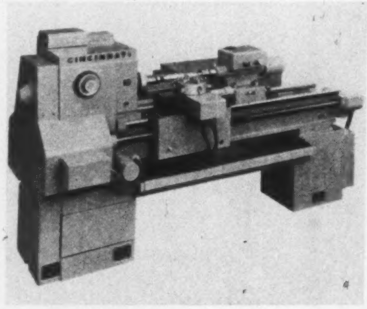

Tape Controlled Lathe

Numerically controlled lathe controls all functions electronically or hydraulically from a program tape located in the control cabinet. The selection of feeds and speeds, selection of tool sequence, positioning of the tools, and length and depth of the cut are all punched into the tape and performed automatically. Operator is required only to load and unload the workpiece, insert the program tape in the tape reader, then start the cycle. The lathe is equipped with six basic turning tools in a turret. Since the selection is automatically controlled by the tape, the turret can be indexed to any one of the tools in any desired sequence. Necks, chamfers, and varying diameters can be cut both toward and away from the headstock. **Cincinnati Lathe & Tool Co.,** 3207 Disney St., Cincinnati 9, Ohio.

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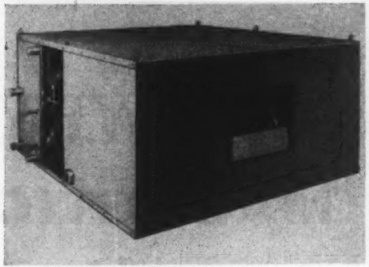

Process Air Conditioner

Line of air units is suitable for producing air temperatures of 38 to 300 degrees, in all combinations of humidity requirements. The units are available in capacities from 2 ton upward. Unit consists of a direct expansion coil, reheat coils where necessary, a blower, filters, and blower motors. Coils are normally supplied with copper tube for the Freon refrigerants and chilled water. Steel galvanized coils can be furnished for use with ammonia, and for special applications, the coils can be furnished in stainless steel. **Rempe Co.**, 340 N. Sacramento Blvd., Chicago 12, Ill.

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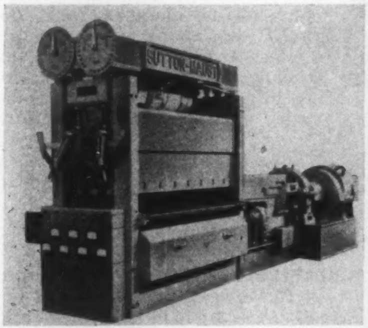


Roller Leveler

Machine is designed for flattening and correcting ferrous and nonferrous sheets and strip, including tension leveling of coil stock. It can be used in process lines, cut-to-length lines, or tension leveling lines. When used in processing lines, motorized adjustments permit remote control. When used in tension leveling lines, material can be processed in coil form rather than in sheet form. Feature of the unit is a double-tilt, backed-up roll arrangement. With this design, the work rolls are cradled by multiple banks of adjustable back-up rolls. The top work rolls are arranged in a symmetrical pattern with the entry and exit rolls adjustable for upward tilt. The entry rolls subject material to gradually increasing waves, while the centrally located roll group produces a series of uniformly deep waves for maximum correcting work and the exit group completes the flattening process.

The symmetrical arrangement of the double-tilt design allows the flow of material to be reversed at any time, without adjustment. The multiple banks of back-up rolls are individually adjustable so localized pressure can be exerted to any portion of the sheet to remove the mill shape from the material. The back-up roll arrangement is designed to prevent work roll markings. The equipment can handle metals of any required width, in gages from 0.001 to 0.750-inch. **Sutton Engineering Co.**, First National Bank Bldg., Pittsburgh 22, Pa.

Circle 413 on Page 19

the Modern Way

TO CUT OFF AND FORM TUBING AND BAR STOCK *IN A SINGLE OPERATION*

Here is a combination that feeds tubing and bar stock — automatically — to a fast, automatic cutting-off machine. Best of all, the pieces being cut off can be formed, grooved, flanged or chamfered at the same time.

There are models that handle tubing, pipe and bar stock from 1/8" diameter up to solid bar stock of 3" OD and tubing up to 8" OD.

Why not investigate?

WRITE FOR CATALOG

MODERN MACHINE TOOL CO.
2005 Losey St. • Jackson, Michigan

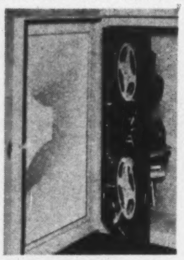
FREE TRIAL OFFER. Safe, positive, fast set-ups. The Modern Safety Drill Table handles odd, irregular shapes without V-blocks, clamps or parallels. Ideal for maintenance work. Guaranteed to save its cost in labor alone every 6 months. Sizes from 8" to 27½" dia. Try it at our expense. No obligation.

Circle 683 on Page 19

9 BASIC REASONS WHY MAGNETIC is your Best

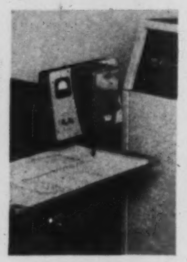
1 **MICRO-PATH IS LOW IN COST**—as little as 1/5 of many comparable systems. This economy is possible because MICRO-PATH *completely sidesteps the need for expensive computers* and intermediate steps. MICRO-PATH records *directly* from any work cycle on any MICRO-PATH equipped machine or with a special recording table.

2



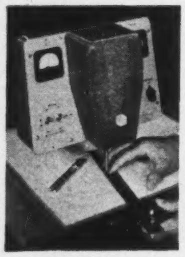
MAGNETIC TAPE RECORDING—The same electrical pulses used to create motion in any desired pattern are simultaneously recorded on magnetic tape. Any work cycle properly executed once can then be repeated accurately.

3



STYLUS RECORDING CONTROL enables an operator to follow a continuous path in one plane merely by "steering" with a stylus. As pressure is applied to the stylus, the MICRO-PATH system generates the necessary electrical pulses to produce motion. Thus by pressing the stylus longitudinally, tranversely or obliquely, motions in these same directions are carried out. Commands for each direction are automatically recorded on separate channels as they are produced.

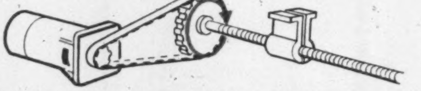
4



SIMPLE PROGRAMMING—The same equipment used to *perform* the work can also be used to *prepare* the program. Most point-to-point programs are numerically plotted on rough sketches according to known X-Y coordinates. Measurements between points are accurately determined by conventional counters. MICRO-PATH can also use such simple devices as templates, compasses, straight edges, triangles, protractors, etc. to produce curved and angular paths, following print specifications.

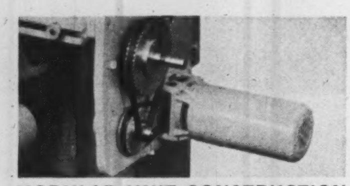
5 **INCREASED ACCURACY**—Where high precision is necessary, such as in machining, scale between print and part *can be electronically reduced 4 to 1.* Just as a pantograph reduces size of machining errors mechanically, the MICRO-PATH reduces them electronically. Tapes can also be recorded at ¼ playback speed, extending the recording time for better operator reflex coordination. However, playback compresses this period to a 4 times faster production rate.

6



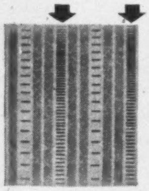
ELECTRONIC BACKLASH ELIMINATION—By applying electrical voltage to a Pulservo, a uniform lead screw backlash can be instantly taken up in either direction before pulses commence rotation. *Electronic backlash is completely independent of the taped program and amount of backlash removal can be pre-set for any machine.* A single, taped program thus becomes universally usable on similar machines. *This feature alone insures high success on MICRO-PATH retrofits* since any machine in reasonably good condition can be satisfactorily automated.

7



MODULAR UNIT CONSTRUCTION permits easy adaption to existing equipment—usually with no more than a properly fabricated bracket.

8



DUAL TRACK RECORDING—Motion in each of 3 axes is simultaneously recorded on dual tracks. This insures electrical reliability at the recording head of 1 part within 1 billion. With the closed loop Pulservo system, complete accuracy in executing all commands is assured.

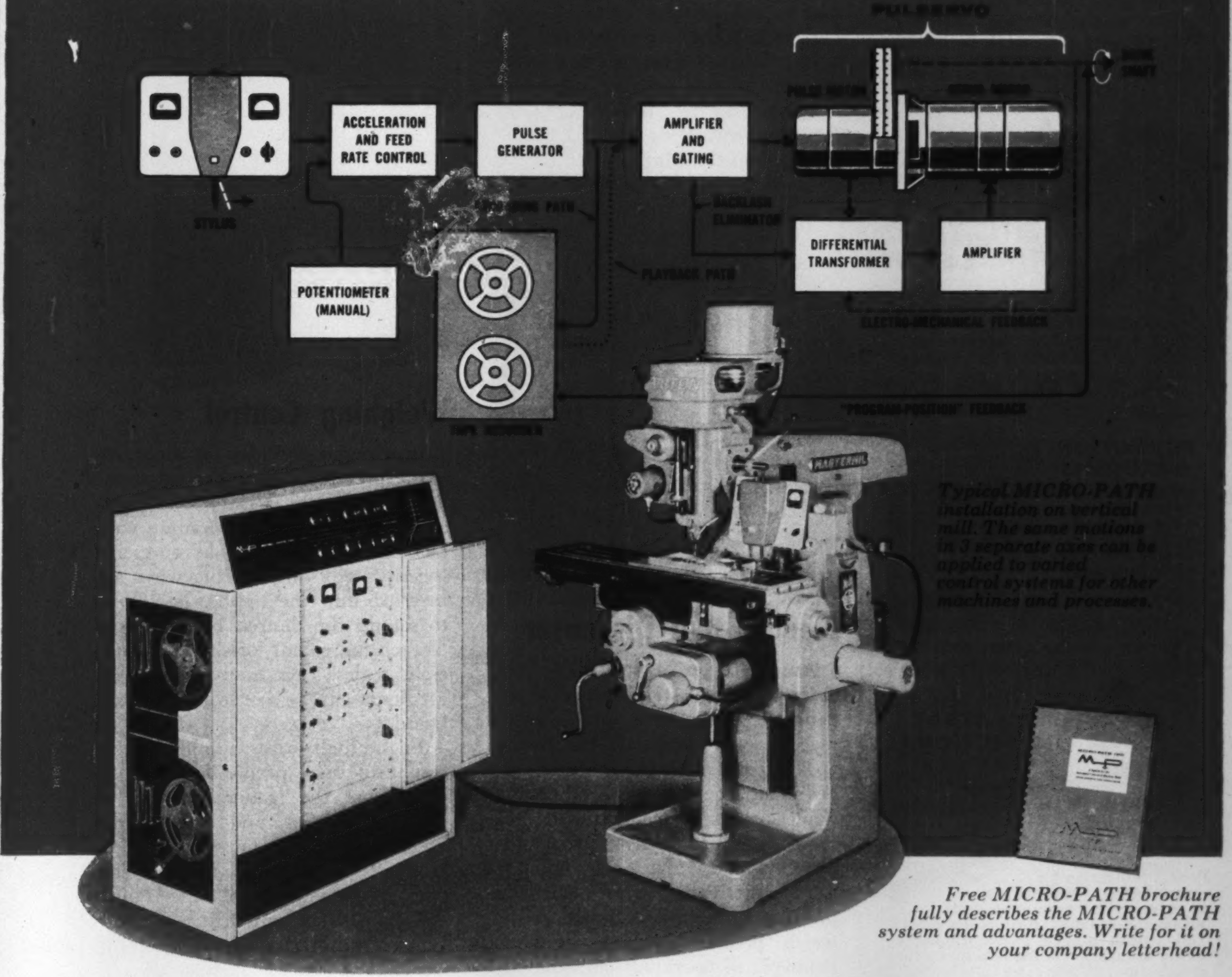
9 **11 INDIVIDUAL CHANNELS** on each tape accommodate a wide range of motion requirements on every program.

MICRO-PATH

TAPE CONTROL

Automation Buy!

HOW THE MICRO-PATH SYSTEM FUNCTIONS


PULSERVO
DRIVE SHAFT
PULSE MOTOR
SERVO MOTOR
ACCELERATION AND FEED RATE CONTROL
PULSE GENERATOR
AMPLIFIER AND GATING
STYLUS
BACKLASH ELIMINATOR
RECORDING PATH
PLAYBACK PATH
DIFFERENTIAL TRANSFORMER
AMPLIFIER
POTENTIOMETER (MANUAL)
ELECTRO-MECHANICAL FEEDBACK
TAPE RECORDER
"PROGRAM-POSITION" FEEDBACK
MASTERMIL

Typical MICRO-PATH installation on vertical mill. The same motions in 3 separate axes can be applied to varied control systems for other machines and processes.

Free MICRO-PATH brochure fully describes the MICRO-PATH system and advantages. Write for it on your company letterhead!

WHATEVER YOUR AUTOMATION PROBLEM, if it involves minute control at reasonable cost, investigate MICRO-PATH! Let our engineers suggest how this unique system can simplify your automation requirements!

MICRO-PATH INC.
A subsidiary of Topp Industries Corporation
10321 Anza Avenue, Los Angeles 45, California
Phone: SPring 6-0450

Circle 684 on Page 19

Hoffman
JIC and NEMA 12
OIL-TIGHT
DUST-TIGHT
ELECTRICAL ENCLOSURES

WALL MOUNTED, in 18 stock sizes.
FLOOR MOUNTED, in double door or multiple door units—11 stock sizes.

JIC NEMA 12 PANEL ENCLOSURES
Ideal for housing electrical controls, components and terminal strips. Note removable mounting panel. Neoprene gasket on door protects against dust, dirt, oil, water. Strong welded construction. No holes or open seams. Also available in NEMA types 1, 3, 4 and 5.

JIC WIRING BOX
Heavy gauge steel, welded seams. No knockouts or holes to leak oil, water or dust. Neoprene gasketed cover with screw clamp makes tight oil-proof seal. Available with or without removable panel. 8 stock sizes from 4"x4"x3" to 16"x14"x6".

PUSHBUTTON ENCLOSURES
A complete selection of types and sizes. Fine quality construction and finish. Welded seams. Cover has neoprene gasket. Holes take any standard oil-tight pushbutton. Types range from "Standard" *as shown*, to Extra Deep, Slim and Pendent. For one to 25 pushbuttons.

OIL-TIGHT JIC SECTIONAL WIREWAY
Perfect protection for control wiring. Neoprene gasket on cover and between joints seals out liquids and dust. Easy to assemble. Full length hinged cover simplifies wiring installation or modification after installation. Stock sizes: 2½"x2½", 4"x4" and 6"x6" in lengths up to 10' with Elbows, "T"s, etc.

We also build enclosures to customer specifications

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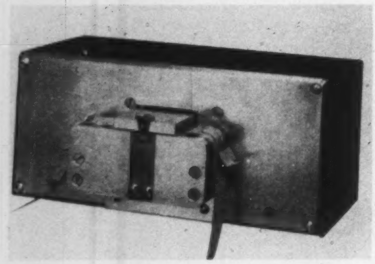
Dept. A-122 Anoka • Minn.

Circle 685 on Page 19



Punched Tape Reader

Block reader, applicable for numerically controlled systems, automatic programming, and testing, is designed for 1-inch, five to eight hole paper, or mylar tapes. Unit can read a fixed block of information in any number up to 48 lines (up to 384 bits) on the tape all at once. Output terminals are available for all bits through special alloy, triple-wire brush contacts. **Wang Laboratories Inc.**, 12 Huron Drive, Natick, Mass.

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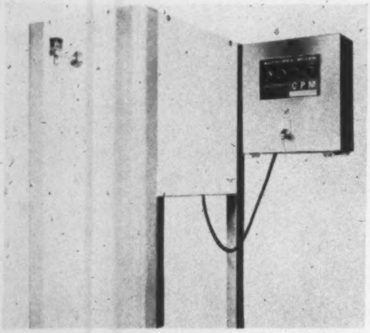


Blender and Dispenser

Automatic unit is suitable for precision processing and accurate dispensing of corrosive and abrasive reactive resin mixes. It can handle epoxy resin mixes for potting, embedment, encapsulation, impregnation, castings, and adhesive applications. Equipment consists of a pump, blender, and valve. The pump is a hydraulically controlled diaphragm pumping mechanism to meter a precision volume of resin. Principle of operation embodies the positive displacement of a piston reciprocating within an accurately honed cylinder cavity which is filled with hydraulic fluid. The hydraulic mechanism is isolated from contact with process material by a fluorocarbon diaphragm imposed between the hydraulic cylinder cavity and the component material chamber. The fluid circuitry is designed to avoid air entrapment and maintain precision processing control. An automatic purging system protects the blender against freeze-up. The air-operated diaphragm valve is actuated upon the end of the pumping stroke. It has a positive shutoff which cuts off flow sharply and prevents any oozing of material from the nozzle. **CPM Special Machinery Corp.**, 324 Butler St., Brooklyn 17, N. Y.

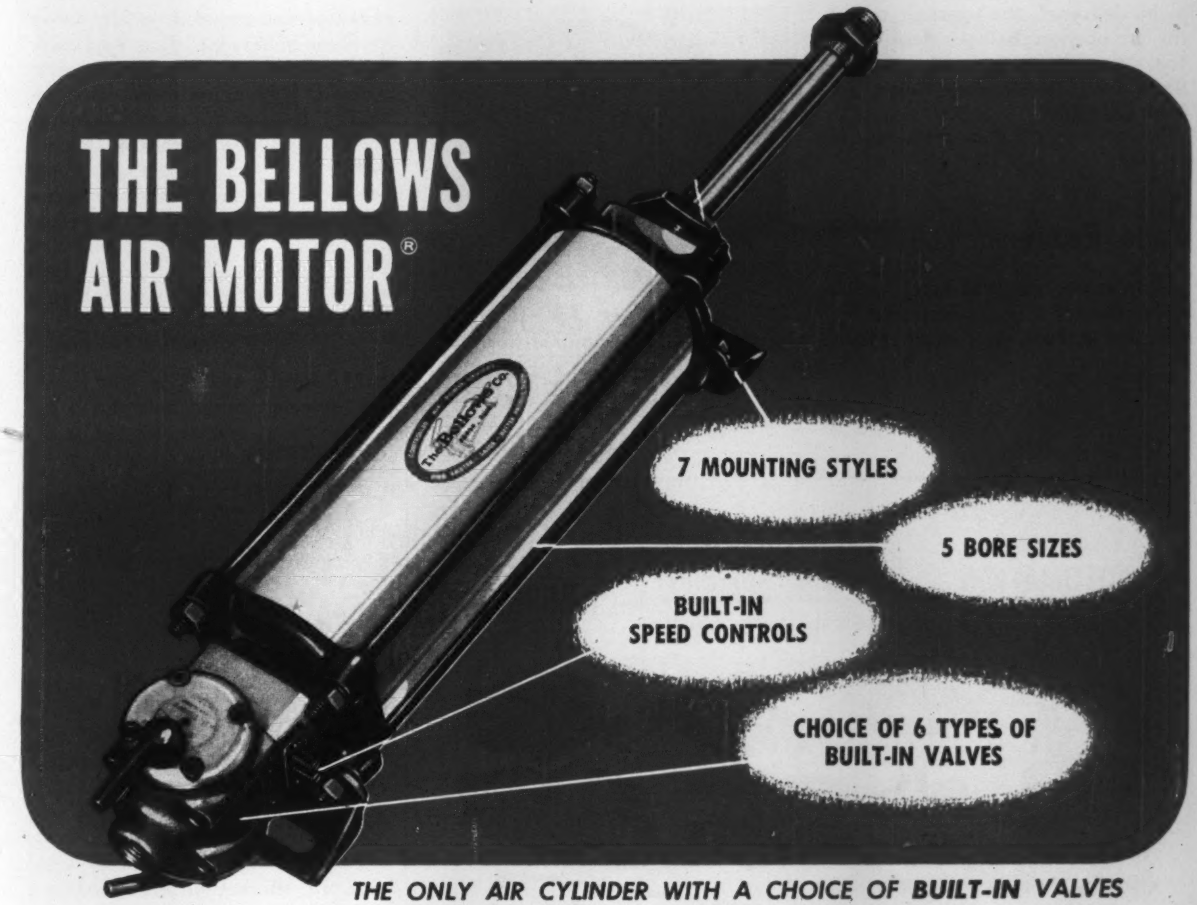
Circle 415 on Page 19

Weighing Control

Instrument provides for the automatic presetting of unlimited numbers of batch formulas. Interchangeable plugboards contain contact holes, with each hole representing a weight value. Plug wires are inserted into the appropriate holes to set up the desired batch weight of each ingredient for single or multiple scales. As many as 20 ingredients can be controlled by one board.

Each plugboard is numbered, representing one specific formula. In operation, the general power is switched to *On*, and after a momentary delay, permitting the electronic components to reach a safe operating temperature, the *Power On* light is illuminated. The operator then selects the desired plugboard and inserts it into the receptacle on the control panel. When the board is inserted, a slight wiping action assures that the contacts make dust-free connection with the programming unit in the panel. If multiple batches of one formula are

THE BELLOWS AIR MOTOR®



THE ONLY AIR CYLINDER WITH A CHOICE OF BUILT-IN VALVES

In designing for air operation, the engineer can choose the method of valving he prefers—and still have all the advantages of integral valve and cylinder construction.

Six different built-in valve arrangements give the engineer every latitude in pneumatic design.

If he prefers to use 8-12 volt electrical control with its simplified wiring, Bellows has it. If he prefers to use 115 volt control and JIC standards, Bellows has it. If he requires low or high voltage explosion-proof control, Bellows has it. Should his design require full pneumatic control, Bellows has it. Or should he wish to control his pneumatic circuits manually or through mechanical linkage or cams, Bellows has it.

Unlike conventional air cylinders which require separate remote directional and speed control valves and dual piping, the Bellows Air Motor is a complete power unit with directional valve and dual speed control valves built-in as an integral part of the unit. Only one air connection, which can be made with flexible hose, is required.

Integral valve and cylinder construction means quick response, more positive response, more precise control and more economical operation.

The Bellows Air Motor is made in five bore sizes: 1¼", 1¾", 2½", 3⅝", and 4½", and in any stroke length.

***WRITE FOR THIS BULLETIN* TODAY!**

AIR MOTOR
what it is
how it works
what it does

627-C

Four-color, 20-page bulletin describes the complete line of Bellows Air Motors. Free on request. Address Dept. AU-160, The Bellows Co., Akron 9, Ohio.

The Bellows Co.
DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)
AKRON 9, OHIO

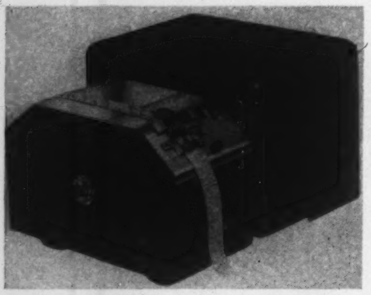
OTHER INDUSTRIAL DIVISIONS OF IBEC: Sinclair-Collins Valve Co., Valvair, Akron, Ohio • V. D. Anderson Co., Cleveland, Ohio

Circle 686 on Page 19

to be delivered, the operator selects the number of batches desired on the preset batch counter. **Toledo Scale, Div., Toledo Scale Corp.**, Toledo 12, Ohio.

Circle 416 on Page 19

Tape Reader



Miniature punched-tape reader set consists of a transmitter-distributor, motor, base, and cover. Model 28 has facilities for sequential (serial) output, hundred-word-per-minute transmission with lower power requirements. It is applicable for on-line data transmission over existing communication facilities and off-line control of tape-operated factory or office machines. Components of the set are available separately for integration with systems equipment. Unit can be furnished to read 5 or 6-level chadless or fully perforated tape. **Teletype Corp.**, Dept. SP-8, 4100 Fullerton Ave., Chicago 39, Ill.

Circle 417 on Page 19

AUTOMATION BUILDING BLOCK = Rotation (Spindles) / Movements (Feeds-Swivels) by STANDARD

. . . just a few MOUNT VERTICALLY or HORIZONTALLY of the SLIDES-FEEDS-SWIVELS or Combinatons thereof as offered in STANDARD's **New Catalog** No. 22 . . . ask for **your** Copy.

ANGLE PLATE MOUNTING: Fig. 1 with Vertical Feed. Fig. 2 with Vertical and Horizontal Feed.

BASE MOUNTING: Fig. 3 with Horizontal Feed. Figs. 4, 5, 6 and 7 with Compound Feeds.

AVAILABLE ON ANY FEED: Power Cylinders (Figs. 6, 10 and 11); Accordion Protectors (Figs. 5, 7 and 8); Right Angle Feeds (Figs. 8 and 9); 360° Swivel Work Base (Fig. 5); 360° Mounting Base (Figs. 8, 9, 11, 12 and 13).

Use SLIDES-FEEDS-SWIVELS for SPINDLES-WORK-FIXTURES ALIGNMENT INSTRUMENTS

"BUILDING-BLOCK" ASSEMBLIES with STANDARD Feeds and Swivels and STANDARD Super Precision Spindles

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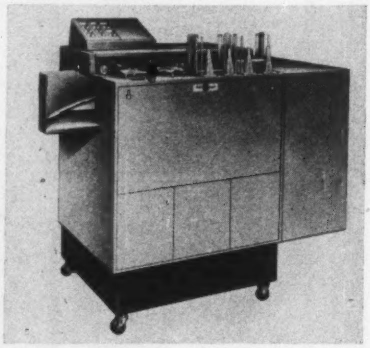
Booth—1430

the STANDARD electrical tool co.
PRECISION SPINDLE AND MACHINE TOOL DIVISION
2550 RIVER RD. • CINCINNATI 4, OHIO

Circle 687 on Page 19



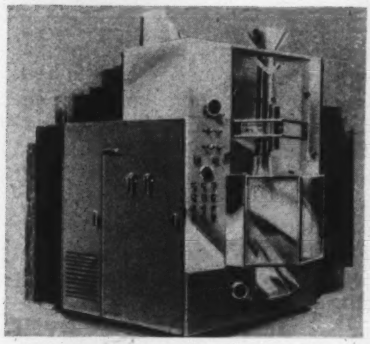
Code Scanning Punch

Machine photoelectrically scans numeric information imprinted on a tabulating card form, then automatically converts that information to punched holes at a rate of 180 cards per minute. It can perform operations such as: Feeding pre-imprinted tab card forms, scanning imprinted code patterns, punching data into the same card scanned, and gang punching fixed data common to all cards in batch. Unit has a scanning capacity of up to 40 digits. It can be equipped with an 80 or 51 column tab card feeder; single, dual, or triple receiving hoppers; and regular or reverse stacking. **Addressograph - Multigraph Corp.**, 1200 Babbitt Rd., Cleveland 17, Ohio.

Circle 418 on Page 19

Bag Former/Sealer

Automatic bag forming, filling, and sealing machine is adaptable to pouch packaging of candy products and frozen vegetables. It can form bags from 3 to 15 inches long and 2 to 8½ inches wide at a maxi-



mum rate of 75 per minute. Model S-750 can handle polyethylene film and other heat sealing materials. Three methods of feeding are available. Transwrap net weight feed provides accurate weighing of free flowing or irregular products through the full range of weights. Auger feed is suitable for products in the fine granule class, such as sugar or for products with a dust factor where control is required right up to the point of packaging. Volumetric feed is recommended for free flowing products without variation in volume measurement. On all three types of feed, the parts in contact with the product are stainless steel or aluminum. **Package Machinery Co.,** East Longmeadow, Mass.

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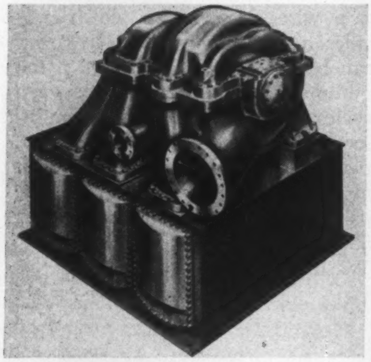

Air Compressor

Multistage centrifugal air compressor is available in six sizes with horsepowers ranging from 1000 to 8000 bhp and capacities from 5000 to 38,000 cfm at 110 psi. Each unit is furnished with a matching driver, intercooler, and lubricating system. Unit is constructed with a single case, has side

A record in precision and reliability with 6 and 8 channel recording systems housed in...

EMCOR®* CABINETS

Sloped-Front Console-mounted 6 & 8 Channel Recording System

Console-mounted recording systems manufactured by BRUSH INSTRUMENTS, Cleveland, Ohio, and housed in EMCOR Cabinets serve as readout stations for telemetry, testing, computer, ground control and other data processing systems.

EMCOR Cabinets offer a compact, versatile and functional housing for industrial or military recording systems. A combination of "human engineering" in cabinet design by EMCOR and instrumentation by Brush Instruments affords simplicity of operation. All controls are within easy reach and visibility of the operator. The flexibility, versatility and structural capabilities of over 600 basic frames in the EMCOR MODULAR ENCLOSURE SYSTEM bring advanced engineering and "imagineering" to meet your packaging requirements. Write for details.

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Originators of the Modular Enclosure System

ELGIN METALFORMERS CORP.
630 CONGDON, DEPT. 1231 • ELGIN, ILLINOIS

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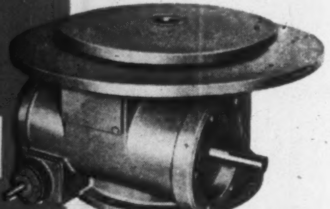
Circle 688 on Page 19

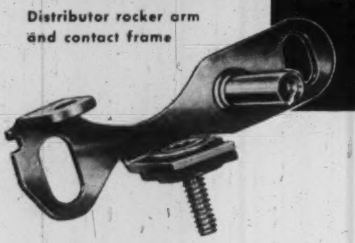
HIGH SPEED ASSEMBLY with Standard Tool Indexing Units

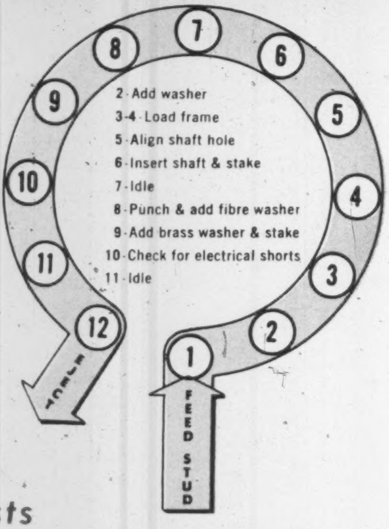
Typical 12 position Model ST-A9 Indexing Unit with precision shot pin locating



Floyd Lyon, Vice President of the Halm Instrument Company, Inc., says:
"We have had fine service experience and virtually no maintenance with Standard Tool indexing units—We have many in service over four years without fault."

Distributor rocker arm and contact frame





At the right is illustrated the operations performed on a recently designed Halm high speed assembly machine. All working units at index stations are cam operated from the index unit cam shaft.

Standard Tool Indexing Units, "The Heart of Automatic Machines" are available in many sizes and types to solve most automatic production problems.

Better Products at Lower Costs thru Better Methods!

Technical Booklets Sent on Request!

Standard Tool engineers will be pleased to help you in selecting the indexing unit to meet your exact requirements.
Also ask for Standard Tool facilities brochure.

STANDARD TOOL & MANUFACTURING CO.
242 LAUREL AVENUE KEARNY, NEW JERSEY

STANDARD TOOL AUTOMATION
Since 1910

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connections for up or down piping. Bearing supports are cast integral with the case and a back-to-back impeller design provides inherent thrust balance. A double thrust bearing absorbs any residual thrust load and accurately locates the shaft axially. The use of isolated bearing chambers and a special seal porting system eliminate lube oil contamination of the compressed air stream. **Clark Bros. Co.**, Olean, N. Y.

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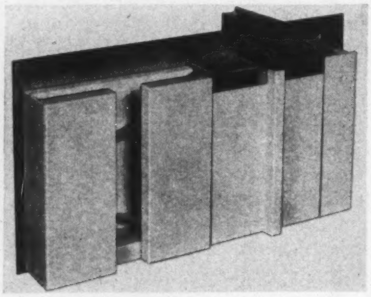

Paper Tape Perforator

Self-contained perforator can punch paper tapes at rates to 60 characters per second. Unit prepares tape from keyboards, tape reproducers, digital counters, and digital data handling systems. It will handle tapes of varying widths up to 8 channels. Feature of the unit is a wire clutch drive which provides a nonsynchronous drive that can be operated at any speed if the minimum time interval between cycles is not less than 16 2/3 milliseconds. Perforator is available in two styles—a panel mounted unit for fan fold tape handling and one using reels. **Tally Register Corp.**, 5300 14th Ave., N. W., Seattle 7, Wash.

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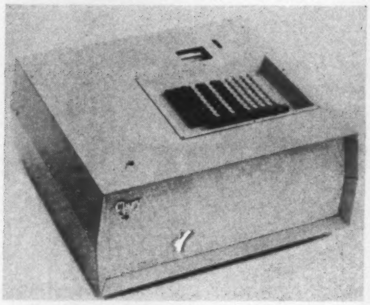
Scanning Printer

Electronic scanning printer is applicable in electronic component checkout systems, quality control evaluation stations, and production line inspection stations. The printer works directly from logical levels, has 12 digit decoding and printing capacity for electronically controlled data from both decimal and binary-coded decimal sources. Input sourc-



es of electrically controlled data include step switch and electronic digital voltmeters, decimal and binary-coded decimal shaft position transducers, electronic counters, step switch banks, relay banks, and selector switches. With the input resistance of the data input circuits at more than 1 megohm, negligible power is drawn from the data originating circuits. **Electronics Div., Clary Corp.,** 408 Junipero St., San Gabriel, Calif.

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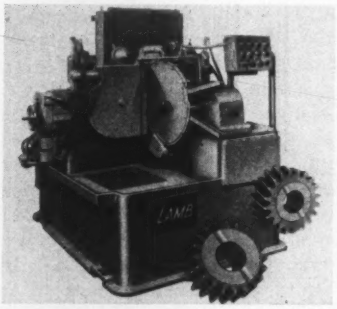

Oil Groove Grinder

Machine is designed to grind oil grooves into both thrust faces of hardened transmission gears at a rate of 800 to 1350 parts per hour, depending on the gear size. Machine operates continuously and includes automatic wheel dressing and wheel wear compensation. In operation, parts are chute fed to a rotating spur type feed wheel that is chain driven. The chain rides on the periphery of the feed wheel and acts as a clamp, holding the parts in the spur pockets as they are passed between the opposed grinding wheels. After grinding, the parts drop out of the spur pockets into a discharge chute. Various sizes of gears can be accommodated by changing the feed wheel. Micro adjustments of the grinding wheel slides can be set for new part width and groove depth dimension. Wheel dressers are also adjustable to any desired radius. Grinding wheels are 16 inches in diameter, $\frac{1}{4}$-inch wide. **F. Jos. Lamb Co.,** 5663 E. Nine Mile Rd., Detroit 34, Mich.

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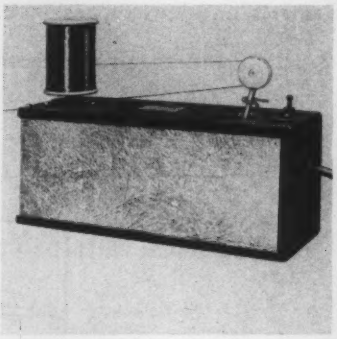


Spool Tension Control

Unit can spool and unspool fine gage material, providing automatic control of tensions. Controllable tension range extends from 1.5 to 140 grams with winding speeds from 0 to 1000 fpm. It is applicable for the winding of electron tube grids, resistors, solenoids, potentiometers, and transformers. Unit operates on alternating current, consists of an ac motor, a control unit, a positive sensing device, and an automatic brake. The motor drive has a high-sensitivity servomotor that provides positive, nonhunting response to tension changes in either forward or reverse directions. The control unit has a variable transformer that is regulated by the sensing device to change the voltage output to the control phase of the motor. In this way, it applies the required torque to correct any changes in tension. The sensing device has a spring-controlled dancer arm and a pulley over which passes the material to be unspooled. The motor drive, the control unit, and the sensing device work in combination with the variable transformer to detect changes from the desired tension on the work material, and regulate the voltage and phasing to the motor to correct the changes. Unit is rated at 5/10 w with a power input of 115 v, 60 cycles, single phase ac. **Diehl Mfg. Co.,** Somerville, N. J.

Circle 424 on Page 19

AIR-HYDRAULICS INCORPORATED

"EXPLODED AIR"

IMPACT HAMMER

MORE STROKES / CU. FT. AIR / MINUTE

NO FOOLIN', when operated at 100 psi line pressure the Model Z-2, 12,000 lb. hammer illustrated will make 50 strokes per cubic foot of air. That's at a rate of 60 per minute on manual control or upwards of 120 on automatic. The Model Z-6, 40,000 lb. capacity hammer will punch out 15 strokes per cubic foot at the same rates.

EASILY ADJUSTABLE to any pressure within capacity, impact is then constant at any point in the stroke. Variations in stock thickness or improper positioning are handled without damage to work, dies or hammer.

FOR THOSE AWKWARD JOBS, from forming to forging, the head of the Z-2 may be purchased separately and mounted at any angle, even upside down.

AIR-HYDRAULICS INCORPORATED

EQUAL PRESSURE THROUGHOUT STROKE

ELIMINATES TROUBLES— caused by material thickness variations, improper seating and other factors. Model C-250 Air-Hydraulic Press shown delivers pressures up to 2½ tons, Model C-300 pressures to 5½ tons on standard air line pressures. May be purchased with stand or for bench installation and equipped for manual control, foot control or fully automatic operation. Speeds up to 3,000 strokes per hour on automatic. Replaces foot or arbor presses on many operations in materials ranging from metals to ceramics.

ADJUSTABLE—Ram pressures may be varied from a feather touch for the lightest jobs to maximum for the heavy ones • Snail speeds if desired • Stroke length adjustment has a 2" range • Effortless quiet operation makes this press ideal for women operators.

OUR NEW CATALOG IS READY NOW.
Write for yours today.

AIR-HYDRAULICS INCORPORATED

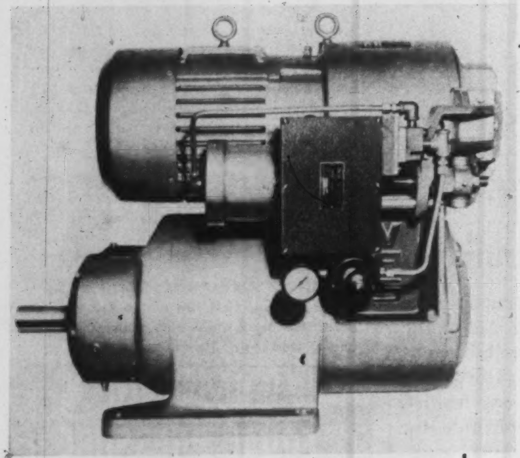
**299 HUPP AVE.
JACKSON, MICHIGAN**

Circle 690 on Page 19

AUTOMATION new components

Parts, elements and devices designed for creating more automatic systems.

For detailed information and literature, use card page 19.



Drive is equipped with an automatic pneumatic control. In a closed-loop feedback system it maintains a constant cutting speed on machine tool applications such as lathes.

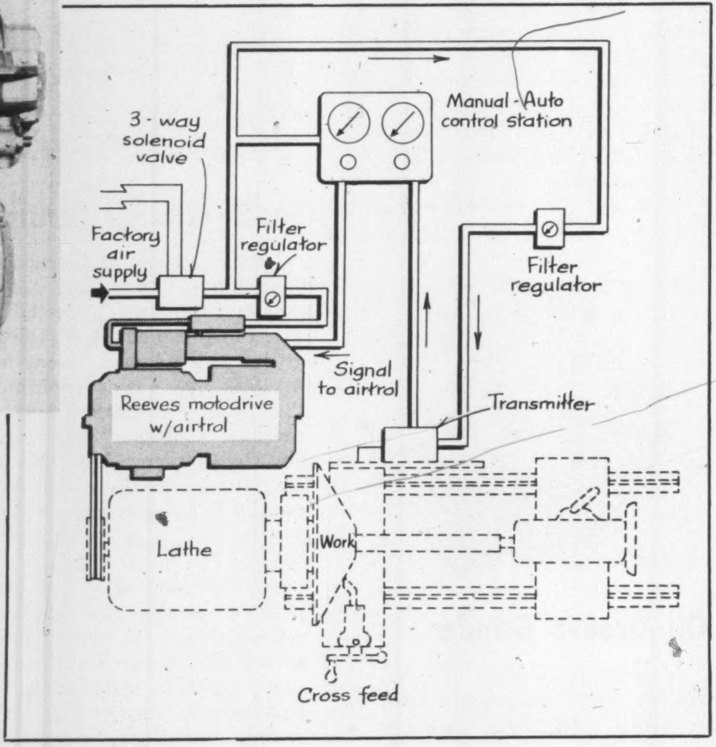

3-way solenoid valve
Factory air supply
Filter regulator
Manual-Auto control station
Filter regulator
Signal to airtrol
Reeves motodrive w/airtrol
Transmitter
Lathe
Work
Cross feed

Diagram shows the position of the drive in a constant cutting speed application on a lathe.

Drive Features Automatic Constant-Speed Control

CLOSED-LOOP control for maintaining constant cutting speeds is a feature of adjustable-speed drive system for lathe applications. Equipment, designed by **Reeves Pulley Div., Reliance Electric & Engineering Co.,** Columbus, Ind., consists of a mechanical variable-speed drive, an automatic pneumatic control, a three-way solenoid valve, a position transmitter, manual-automatic remote control station, and filter regulators. It is available in sizes from ¼ through 40 hp, 1.7 through 4660 rpm, in 2:1 through 10:1 speed variations.

In operation, the variable-speed drive, producing an adjustable output speed, drives the lathe spindle. As the cutting tool cuts across the face of the part being machined, a pneumatic positioner in the control receives an air signal indicating a change in working diameter, and the output speed of the drive is automatically adjusted to maintain constant cutting speed. A switch on the operator's station converts the system from manual to automatic spindle speed control. When the variable-speed drive is turned off, a solenoid valve is energized to hold the speed setting while the machine is idle.

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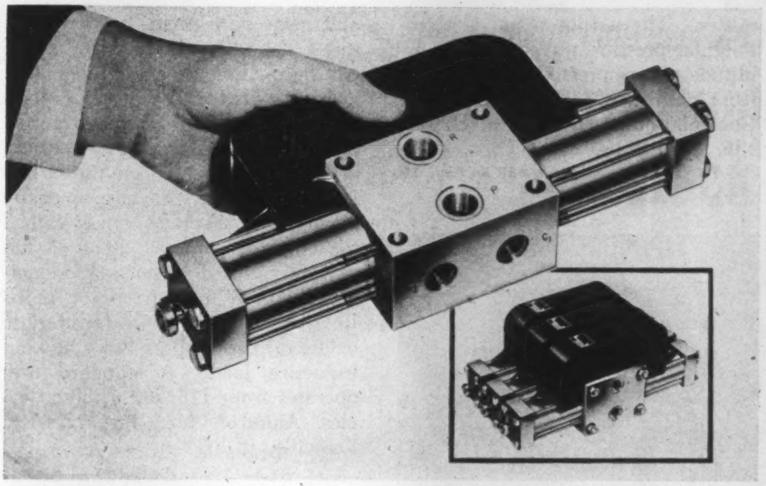

Solenoid Valve Has High Pressure Ratings

Suitable for use on machine tools, automatic controls, packaging machinery, and metal-forming equipment, line of 4-way, ac solenoid valves feature high fluid capacity, high pressure ratings, and low current consumption. As shown in the illustration, they are designed for easy stacking or banking, without the use of special base plates or manifolds. The valves are available in $^3/_8$-inch pipe size, in three designs — closed-center, tandem, and two-position. They are rated at 3000 psi, with rated pressure applied to all ports. The direct-actuated spool requires no back pressure or minimum flow for proper operation. The inner design and full-size porting provide low pressure drop; about 60 psi at 5 gpm.

As there is no excessive heating with fast cycling; cyling rates greater than 60 cpm are possible. The valves are available for 110 or 220 v operation, using the same coils at a frequency of 25 to 60 cps. Power consumption is 25 w per coil at all voltages. The valve body material is high-strength aluminum alloy, with heat-treated steel spools and sleeves. All working parts of the valves are totally enclosed and immersed in the hydraulic fluid and there are no moving seals to cause sticking or external leakage. **Waterman Hydraulics Corp.,** 725 Custer Ave., Evanston, Ill.

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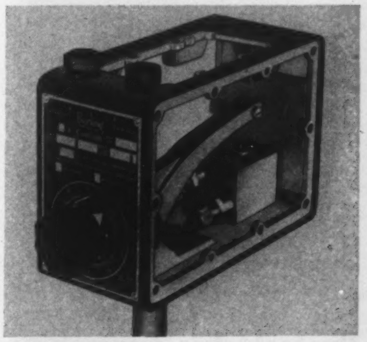
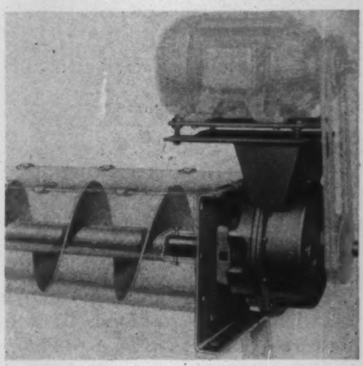
Temperature Control

Temperature transmitter can be used to provide air pressure proportional to temperature in the direct operation of air-operated diaphragm valves, motors, dampers, or similar equipment. It can also be used as a high temperature limit. Feature of Model OA is a differential expansion actuating tube which allows operation from subzero to 2000F. The temperature setting is by means of an external knob.



Heat sensing element works by differential expansion of two metal tubes. The outer tube has a higher coefficient of linear expansion than the inner one. An increase in temperature causes the outer tube to expand more than the inner one; this in turn allows a spring to move a lever toward the valve. The air system has a pilot valve of the bleed type. Supply air at pressures up to 50 lb is connected to the inlet. The output pressure varies inversely with temperature (pressure decreases as temperature increases) which results in a modulating action that permits close control. **Burling Instrument Co.,** 16 River Rd., Chatham, N. J.

Circle 427 on Page 19



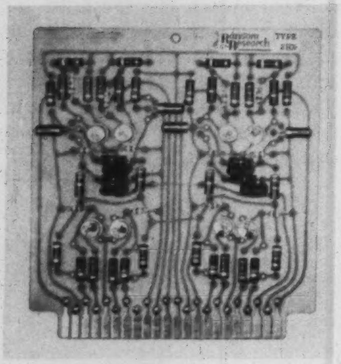
Screw Conveyor Drive

Helical gear drive, with an optional motor mount and trough end, is designed to simplify the operation and maintenance of screw conveyors. The basic unit is a reducer with drive shaft and seal housing. The drive which is adaptable for all conveyors requiring ½ to 30 hp is furnished in six sizes, each with ratios of 4:1, 9:1, 14:1, and 24:1. By means of a quick snap ring arrangement the drive shaft can be removed, in some instances, without disturbing the reducer or screw. The trough ends are available in eight sizes, from 6 to 20 inches. A choice of seals between conveyor and reducer is offered, including waste packing, felt seal, or lip seal. **Falk Corp.,** Dept. 255, Box 492, Milwaukee 1, Wis.

Circle 428 on Page 19

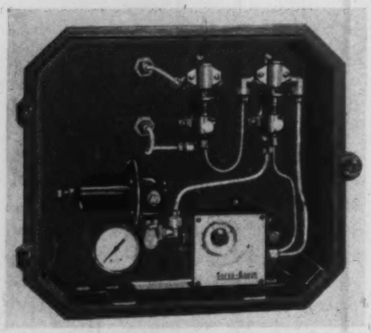
Dual Flip Flop Circuit

Model 2HX has two independent 1 mc flip flop circuits, packaged as a single plug-in printed circuit card. It is suitable for use in high speed computer and control systems. Each of the flip flops employs two transistors in a circuit, a transistor amplifier at the output of each side of the flip flop (to provide high power output) and two transistors at the input of each side of the flip flop (to provide proper gating of the



input signals). Correct timing is maintained by a 1 mc clock pulse from an external source. Set 0 and set 1 levels of +5 to +12v are accommodated. Output rise time is less than 0.5 microsecond; fall time is less than 0.2 microsecond. **Ransom Research**, 323 W. 7th St., San Pedro, Calif.

Circle 429 on Page 19



Servo-Gage Oscillator

Essentially a pneumatically actuated timer, suitable for use in explosive hazardous areas, the instrument is applicable to speed control of diaphragm pumps, on-off control of cylinder or diaphragm operated valves, and the timing actuation of power cylinders. Unit sends out, on a predetermined time cycle, a repetitive signal impulse of a preset magnitude, or of a variable magnitude if it is initiated by a controller. The signaling impulse frequency, variable from 0.3 to 60 cycles per minute, is adjustable within the instrument case. Amplitude of the output pressure can be adjusted manually at the instrument or at a remote control center, or automatically by a pneumatic transmitter. The output signal is a rectangular pressure wave with an amplitude of any pressure in the range from zero to 30 psig. **Associated Control Equipment Inc.**, P. O. Box 136, Coraopolis, Pa.

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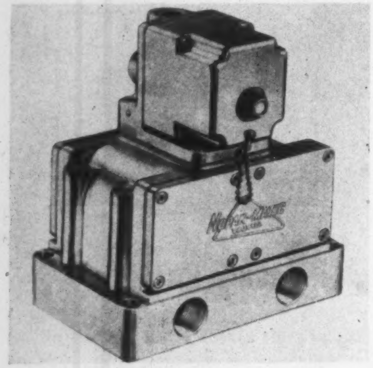
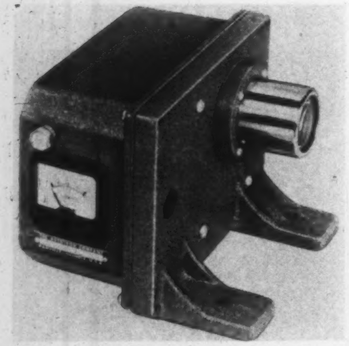


4-way Valve

Adaptable for fast cycling of large bore cylinders, unit is available in master, single solenoid (shown), and double solenoid styles. Features of the unit are: Large body orifices, freedom from obstructions, and a capability for passing a large volume of air or hydraulic fluids. The valve is furnished in $\frac{1}{4}$ to $1\frac{1}{4}$-inch pipe sizes. **Nopak Div., Galland-Henning Mfg. Co.**, 2753 S. 31st St., Milwaukee 46, Wis.

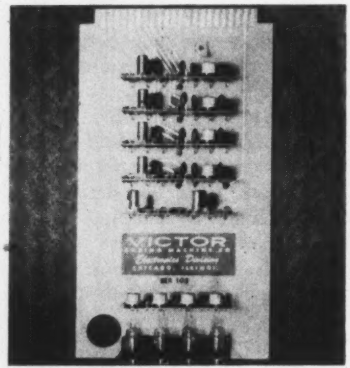
Circle 431 on Page 19



Photoelectric Control

Device protects against machine stoppage because of tube or circuit failure. Model A-373 maintains a closed circuit only when the photoelectric current is not less than 7 and not more than 8 ma. The safety action is obtained by use of two light-energized plate relays that are connected in series. Contacts of the two relays are also connected in series so that when the contacts of either relay are open the circuit is open. Relay *A* has normally open contacts and energizes with 7 ma current or more. Relay *B* has normally closed contacts and energizes with 8 ma current or more. Relay contacts are silver cadmium oxide, rated 8 amp at 115 v ac noninductive load. A standard unit operates from 115/230 v, 50-60 cycles. **Autotron Inc.**, Box 722 RR, Danville, Ill.

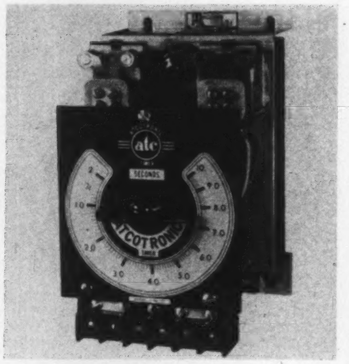
Circle 432 on Page 19



Reversible Counter

Transistorized decade counter can subtract as well as add through electronic pulses. It is adaptable for operations such as flow, tally, and computing. Isolated output signals are provided to drive external devices such as printer drives, predetermined count detectors, and digital-to-analog converters. The counter requires a positive input transition of 2 to 3 v in amplitude with a rise time of less than 1 microsecond or a pulse greater than 0.25 microseconds in width. Input pulse trains can be derived from a single source or multiple sources. The components are operated through a logic control board which indicates the sign of the stored count and determines the action to be taken (count up, addition, or count down, subtraction). **Victor Adding Machine Co.**, 3900 N. Rockwell St., Chicago 18, Ill.

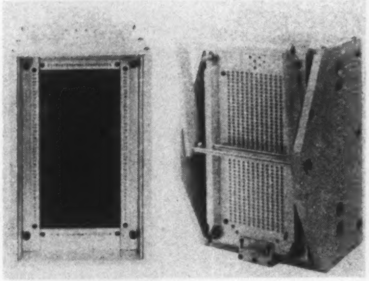
Circle 433 on Page 19



Electronic Timer

Printed circuit electronic timer for short interval time control features two heavy contact, four pole, double throw relays. The relays are mounted vertically to minimize collection of dust particles, are easily accessible for maintenance. Model 5231-B is rated at 15 amp, operates on 115 v, 60 cycles. Single and dual timing ranges available include 0.02 to 1 second, 0.04 to 2 seconds, 0.05 to 3 seconds, 0.2 to 10 seconds, 0.4 to 20 seconds, and 0.5 to 30 seconds. Maximum standard ranges available are 60 seconds and 120 seconds. Printed circuit design provides a reliability that is unaffected by temperature variations from 0 to 100 F. **Automatic Timing & Controls Inc.**, King of Prussia, Pa.

Circle 434 on Page 19

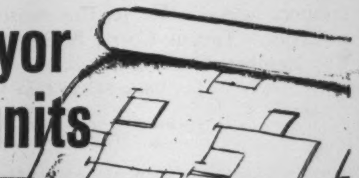


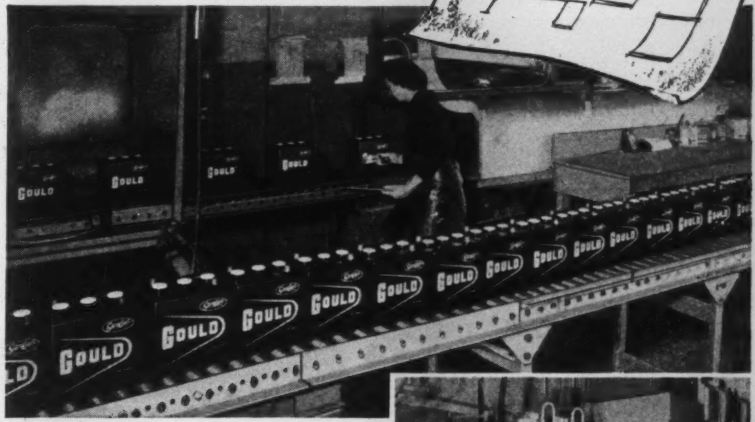
Punched Card Sensor

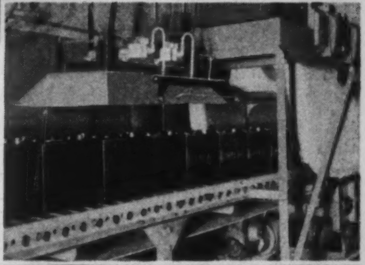
Device statically reads an entire punched card at one time, is adaptable to both IBM and Remington Rand card users. It is applicable in chemical, gas, and oil processing, for steel mill and machine tool control, and automatic test equipment. It is also practical for a large number of programs (50 and up) which involve only simple

Multi-plant conveyor conversion problem solved with

Standard Conveyor stock units







Gould-National makes full conversion in 90 days

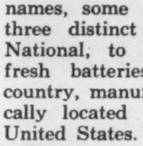
Gould-National Batteries, Inc., makes batteries for hundreds of sales organizations, each having its own color combinations in trade marks and brand names, some requiring as many as three distinct shades. And Gould-National, to insure distribution of fresh batteries everywhere in the country, manufactures in 16 strategically located plants throughout the United States.

Battery manufacture is a highly standardized, mass-production operation. Economical application of painted multiple colors on the cases posed real problems in methods and equipment. The conversion at Gould-National required equipping 16 plants simultaneously with painting equipment and conveying systems coordinated with existing production lines.

Methods engineers at Gould-National made the multi-plant conversion in the record time of 90 days . . . using Standard Conveyor stock units, including Handidrive power unit, with big savings in cost. And what do these engineers say about Standard Conveyor? "Best possible method for our type of operation!"

Illustrated are scenes from the St. Paul plant of Gould-National. Line was designed to produce 3,000 multi-colored batteries in 50 different sizes and colors per day.

When you have a materials-handling problem, call Standard — more than 50 years of conveyor engineering experience. Standard Conveyor Company, General Office: North St. Paul 9, Minnesota.



OVER 50 years of conveyor experience

Call the Standard engineer listed in your classified phone directory or write direct for Bulletin 309—address Dept. EE-1.

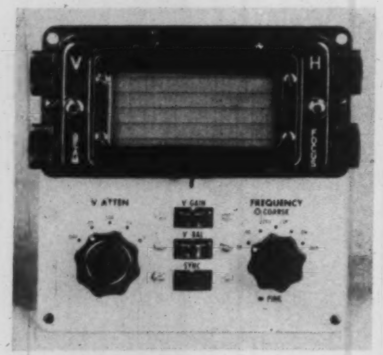
Standard
GRAVITY & POWER
CONVEYORS

Sales and Service in Principal Cities

Circle 691 on Page 19

switching. A feature of the unit is the taper tab receptacles which connect users leads to the sensor switches. **Taurus Corp.**, 8 Coryell St., Lambertville, N. J.

Circle 435 on Page 19



Oscilloscope

Instrument, designated Panelscope, features a sensitivity of 100 mv rms with a band width of dc to 1 mc. Compensated attenuator steps of 1, 10, 100, and 1000 together with a 10:1 nonfrequency discriminating vernier provide a 10,000:1 range of attenuation continuously variable. Unit also has a repetitive sweep continuously variable from 10 cycle to 20 kc. It will operate on 115 v ac, 38 ma of +325 v dc and 2.1 amp of 6.3 v ac. **Waterman Products Co. Inc.**, 2445 Emerald St., Philadelphia 25, Pa.

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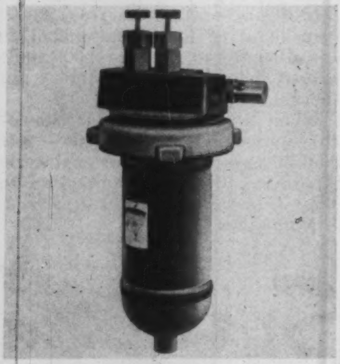

High Pressure Filter

Applicable for air, water, gas, or oil filtration, unit will operate at pressures up to 2000 psi. Feature of the unit is a built-in relief valve which allows the filtered media to by-pass the filter cartridge if a pressure drop of 15 psi occurs due to clogging. An indicator shows when the filter is being by-passed. Device is furnished with up to three filter cartridges of 5, 25, 50, or 75 mu. By closing the inlet and outlet by-pass valves, thus causing the relief valve to open, the filter cartridge can be changed without interrupting flow. The cartridge is changed by releasing the hammer union, installing the new cartridge and retightening the hammer union, and opening the by-pass valves. **Instruments Inc.**, P. O. Box 556, Tulsa, Okla.

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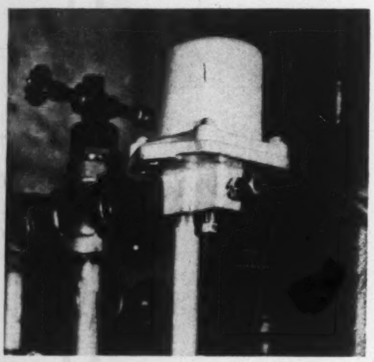
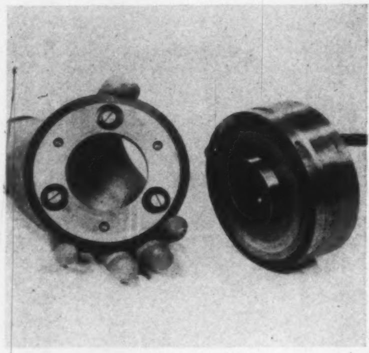


Pressure Detector

Instrument can measure gas, fluid, or vapor pressures and convert the pressure directly to an electrical resistance without the use of an amplifier. It is used in combination with an Omniguard monitor. Model 328 RPD is available in a wide variety of ranges so that low pressures, measured in inches of mercury, to pressures of 3000 psi can be watched constantly. Each alarm pressure can be changed at any time by means of a simple screwdriver adjustment on the front of the monitor. For pressures under 30 psi, a precision capsule is the sensing element. For pressures from 30 to 3000 psi, special Bourdon tube elements are used. The unit is normally mounted in a pressure detector head to protect it and the lead wires from damage. **Instrument Div., Thomas A. Edison Industries, McGraw - Edison Co.**, West Orange, N. J.

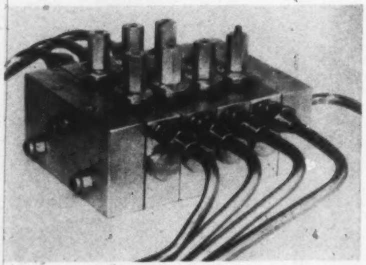
Circle 438 on Page 19



Face-Tooth Clutch

Adaptable for machine tool feed, tracer and positioning drives, face-tooth clutch is available in five ratings from 30 through 725 lb-ft of torque. The clutch eliminates maintenance because there are no air gap adjustments to be made, or no slip rings and brushes to be cleaned, adjusted, or replaced. Device uses three or six drive pins to provide a simple attachment to the driven member. Engagements are made in as little as 0.040 second, disengagements in 0.020 second. An armature spring arrangement assures positive separation of clutch elements. Clutch is furnished for either 24 or 90 v dc operation. **I-T-E Circuit Breaker Co.**, 1900 Hamilton St., Philadelphia 30, Pa.

Circle 439 on Page 19



Blocked Line Indicator

Unit can detect and pinpoint a blocked line condition in an automatic, progressive type centralized lubrication system. When the blocked condition is cleared, the indicator pin will automatically return to normal position. The indicator is screwed into the alternate outlet or test plug tap of each outgoing line from the master and secondary distributors of the system. Indicator is available in spring pressures ranging from 250 to 2500 psi, in 1/8 and 1/4-inch pipe sizes. **Trabon Engineering Corp.**, Solon, Ohio.

Circle 440 on Page 19

TREPAC
MODEL No 550
TELEPRINTER AUTOMATIC

Solid State Relay

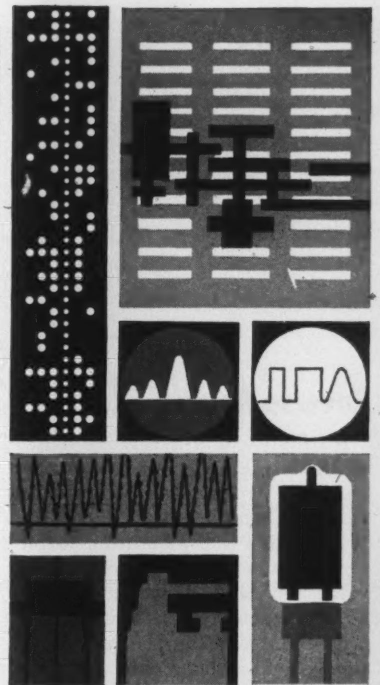
Device is designed for installation in any commercial teletypewriter and provides for automatic control of the printer drive motor. In operation, the electronic relay energizes the motor at the first signal pulse, sustains operation throughout the transmission, and shuts down the motor after completion of the message. Unit draws negligible current during idle periods, operates immediately when triggered, and dissipates no heat during operation. In the event of line or signal failure, the relay will automatically shut down the printer motor and remain ready to resume operation when service is restored. Model 550 can operate over a temperature range of −20 to +71C. **Trepac Corp. of America**, 30 W. Hamilton Ave., Englewood, N. J.

Circle 441 on Page 19

Lo-Vac
SWITCH
ON
OFF

Negative Pressure Switch

Device is suitable for use in any operation where very low suction



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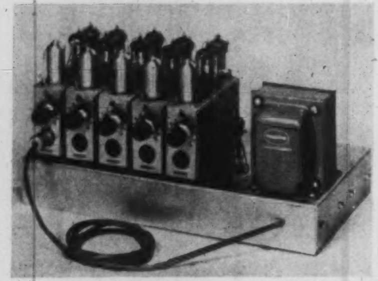
SPECIALTY CONTROL DEPARTMENT

GENERAL ELECTRIC

Waynesboro Virginia

will create a hazard, such as in ovens, steam generators, paint baking, drying and finishing ovens, and stack draught inducers for flue duct draught control. Switch has a positive *On-Off* indicator which shows its position. When it is installed on the suction side of a system, it becomes the main part of the system, interlocking the ventilating equipment, fuel supply, and safety devices. Switch will operate on 4 amps at 115 v and 2 amps at 230 v ac or dc. It closes at 0.21-inch of water; opens at 0.10-inch of water. Maximum setting is from 0.30 to 0.15-inch of water. **Gas Appliance Specialties Co. Inc.**, Dept. LV-39, 32-37 56th St., Woodside, N. Y.

Circle 442 on Page 19



Temperature Controller

Multichannel electronic proportioning and *On-Off* temperature control instruments can continuously measure temperature and electronically compare the measurement with a set-point temperature reference voltage. The *On-Off* controller automatically turns heat on or off to maintain temperature at the desired set-point; the proportional controller precisely measures how much too hot or too cold the process is and automatically proportions the length of time heat is applied. Up to five separate temperature control points can be used on a single power supply chassis. An anticipating section can be added to either type of controller (*On-Off* is shown in the illustration) to provide closer degrees of control. With the anticipating section, control capability of the proportional instruments is ±0.25 F and ±0.5 F with the *On-Off* unit. **Electronic Processes Corp. of California**, 436 Bryant St., San Francisco 7, Calif.

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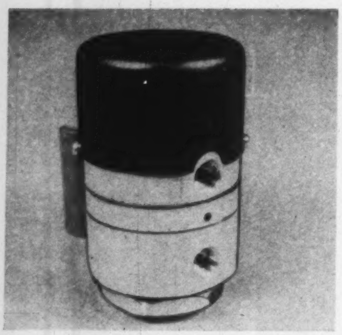
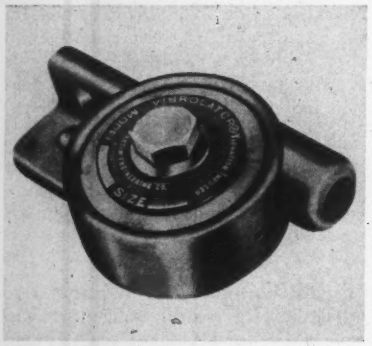


Reverse Relay

Auxiliary unit can be used wherever the action of a controller must be reversed. It can be mounted behind control panels, or adjacent to a wall-mounted controlling instrument, or directly on a valve or damper motor. Model 783 operates on a force-balance principle, balancing the pressure of supply and exhaust air against a calibration spring. The fixed 1:1 input to output ratio produces a 1 psi change in return pressure for each psi change in thermostat pressure. Air is used only when the pressure changes. Normal supply pressure is 15 psi; maximum supply pressure is 25 psi. Maximum temperature is 160 F; minimum temperature is −20 F. **Powers Regulator Co.**, 3411 Oakton St., Skokie, Ill.

Circle 444 on Page 19



Vibration Inducer

Designed to handle bins with 4 cu-ft storage capacity, vibration inducer can bring powdered, particulate, or granular materials out of hoppers and down chutes. Vibration in model BD-10 is generated by a rolling ball pneumatically driven in an orbit on replaceable raceways of hardened, high alloy steel. The device can be used in explosive atmospheres and is not harmed by ambient temperatures. Air consumption is 3 cu-ft per minute, and it will operate on as little as 5 psi pressure. The inducer can be mounted in any position with a single bolt. **Martin Engineering Co.**, Neponset, Ill.

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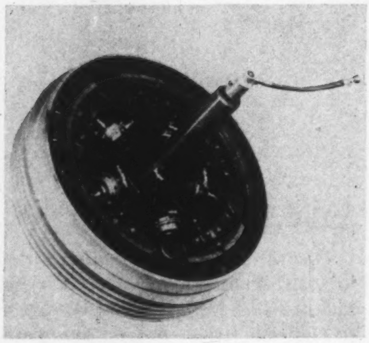


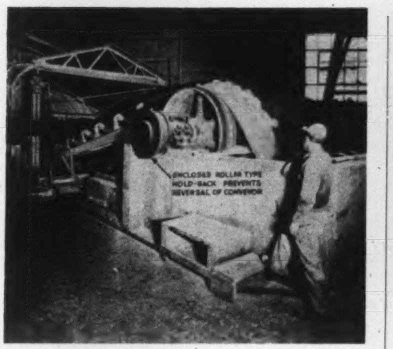
Air Cooled Clutch

Slip clutch can control tension in center winding operations by an automatic or manually operated pressure regulating control. An air gage shows the pressure at which the clutch is operating and also what tension is on the roll material. Unit is designed to dissipate heat and give uniform torque output at intermediate speeds. Only one pressure regulating control operates the clutch. The tension is varied by air pressure fed to friction shoes which press against the clutch face. **Horton Mfg. Co. Inc.**, 1179 15th Ave., S. E., Minneapolis 14, Minn.

Circle 446 on Page 19

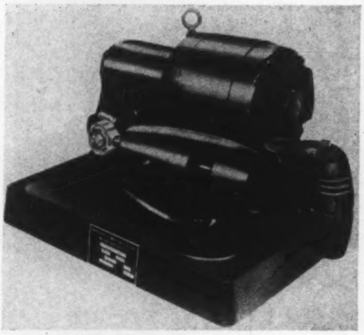
Conveyor Holdback

Protective device is designed to prevent loads in bucket elevators and inclined conveyors from traveling backward when they have been stopped. The holdback is installed on the head shaft of a conveyor or elevator, operates on the roller wedge principle. When power is interrupted or when the loaded belt make the slightest move backwards, the rollers wedge between a drum


ENCLOSED ROLLER TYPE HOLD-BACK PREVENTS REVERSAL OF CONVEYOR

or housing and a wedge-plate preventing reversal, quickly and without appreciable shock. When forward travel is resumed, the unit releases freely. Unit is furnished in two styles. The roller type holdback is available in bore sizes from 1-7/16 to 8 inches, and the totally enclosed type holdback is available in bore sizes from 2-7/16 to 12 inches. **Stephens-Adamson Mfg Co.,** Ridgeway Avenue, Aurora, Ill.

Circle 447 on Page 19



Chemical Feed Pump

Controlled capacity pumps feature a self-contained lubricating system which makes it unnecessary to shut down pumps for lubrication. The simplex pumps have a capacity of 812 gph—duplex pumps have double this capacity with maximum pressure of 10,000 psi. They have a repetitive metering accuracy of ±1 per cent. The units are designed to move specific volumes of fluid, including corrosive materials, into high or low pressure systems in almost all desired ratios with flow, temperature, pressure, conductivity, pH, and other process variables. **Pump Div., American Meter Co.,** 13500 Philmont Ave., Philadelphia 16, Pa.

Circle 448 on Page 19

BECKETT *Hi-Cyclic*

the valve name you need to know to fill any directional control application!

Beckett Hi-Cyclic Valves are sealed by **precision,** metal-to-metal fit. There are no working packings. Only the brass valve body and stainless steel spool are in contact with the media. These valves give **longest service life!**

Seven spool types meet all requirements. Special spools to specifications. Short spool stroke gives extremely **fast** reaction.

Practically every Beckett Hi-Cyclic Valve (more than 150 models) is a variation based upon a compact, basic valve body. By adding suitable actuators, the basic valve is adapted to almost any given situation. Many actuator assemblies can be combined or interchanged, thus making the line of Hi-Cyclic Valves almost **universal** in range of application.

"SPECIALS" WELCOMED!

If a standard Hi-Cyclic Valve will not fulfill your needs, we welcome the opportunity to economically design and manufacture the valve to your most exacting specifications.

Write for complete valve catalog or detailed information on Hi-Cyclic Valves to meet your requirements.

NFPA NATIONAL FLUID POWER ASSOCIATION MEMBER

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BECKETT-HARCUM COMPANY

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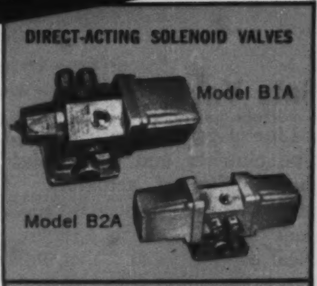
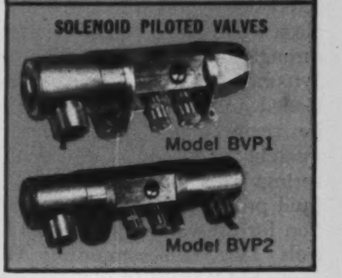
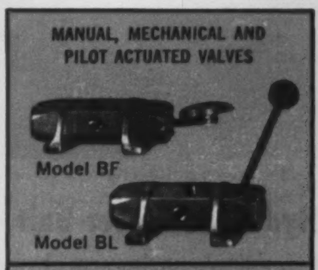
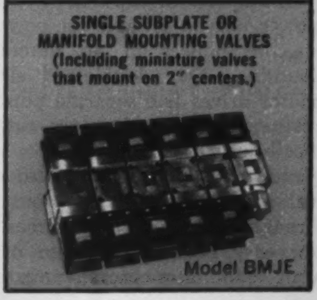

DIRECT-ACTING SOLENOID VALVES
Model B1A
Model B2A


SOLENOID PILOTED VALVES
Model BVP1
Model BVP2

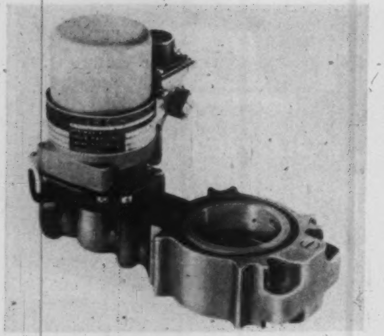
THE COMPLETE LINE OF PRECISION AIR AND HYDRAULIC CONTROL VALVES.

N.P.T. SIZES 1/8" TO 1"


MANUAL, MECHANICAL AND PILOT ACTUATED VALVES
Model BF
Model BL


SINGLE SUBPLATE OR MANIFOLD MOUNTING VALVES (Including miniature valves that mount on 2" centers.)
Model BMJE

Circle 692 on Page 19



Gate Valve

Line of gate valves features roller type clutches and complete interchangeability of actuators. They are adaptable to custom specifications including variations in electrical connectors and thermal characteristics. The valves are of one-piece lightweight construction with through-mounted bolts. The teflon dynamic seals are mechanically-loaded and retained. The seal can be removed as a complete subassembly without disassembling springs or loading devices. The fluid provides the complete lubrication for the valve. **Whittaker Controls Div., Telecomputing Corp.**, Dept. SMA 551, 915 N. Citrus Ave., Los Angeles 38, Calif.

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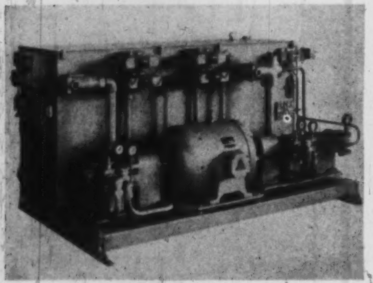

Hydraulic Power Unit

L-shaped, multipump hydraulic power unit is suitable for powering a core blower in an automated foundry. One double-end electric motor drives five separate pumping stations. The stations are automatically controlled by high-low valve panels and solenoid-controlled relief valves. External connections are brought out to a flanged manifold for easy hook-up. Design of the unit eliminates excessive external piping and valve panels. With the top removed, it is possible to see fluid from individual drain and return lines while the unit is running. **Double A Products Co., Subsidiary, Brown & Sharpe Mfg. Co.**, Manchester, Mich.

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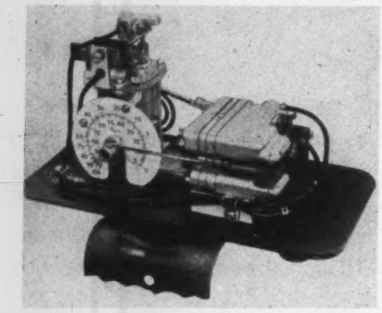


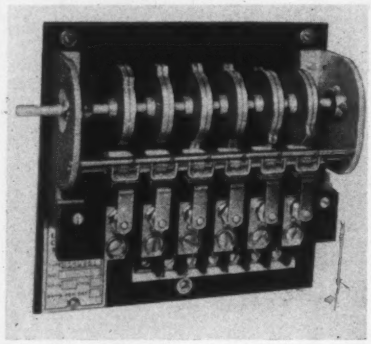
Function Generator

Designed for flow readout and control, function generator can convert a pneumatic input signal into a characterized output, linearizing the signal from a differential pressure type flow transmitter. Unit consists of a pneumatic servo and a set point transmitter, utilizes a 3-15 psi input signal from a transmitter and produces a linearized 3-15 psi output signal to a receiver or controller. The feedback element of the servo is a precision cam, cut in accordance with the desired nonlinear function. The position of the servo pulley will be that function of the pneumatic input signal to the sensing capsule of the servo. The servo pulley is connected by a flexible metal tape to the transmitter which converts pulley position into a proportional pneumatic output signal. **Taylor Instrument Companies**, 95 Ames St., Rochester 1, N. Y.

Circle 451 on Page 19

Cam Limit Switch

Rotary cam limit switch has from 2 to 16 individual circuits, and will operate at speeds up to 300 rpm. Features of the switch are a ball bearing supported cam shaft and nylon roller cam followers. There are 3/8-inch coin silver nonflexible contacts rated at 15 amp. The 2-inch diameter nickel plated cams provide accuracies to 1/2 per cent. The 1/4-inch cam shaft extends beyond the bearing mounting for connection to an external drive. **Eagle Signal Co.**, 202 20th St., Moline, Ill.



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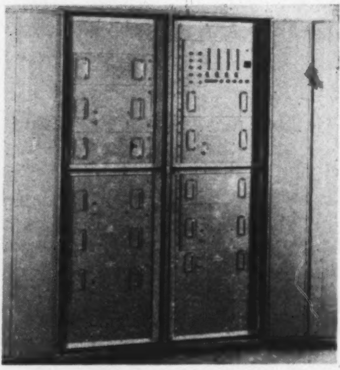

Reset Control System

Automatic digital control system is designed to position the rolls of a hot strip mill and assure the desired thickness of sheet steel. System includes five control channels which simultaneously reset the rolls of five stands (it can control any number of stands). An automatic gage controller provides the directions for resetting the position of the screwdown rolls, with an accuracy of 0.001-inch. The system provides facilities for storing the selected roll position of each of the stands. After receiving a reset command, the system automatically repositions the rolls to the previously stored position. If the reset signal is interrupted during the positioning operation, the control system supplies a *Stop* command. **Datex Corp.**, 1307 S. Myrtle Ave., Monrovia, Calif.

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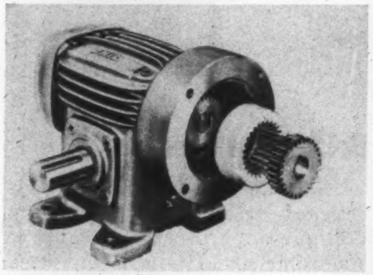
Speed Reducer

Line of fin and fan cooled speed reducers is available with either of two types of *C* flanges. One style permits direct connection of the motor shaft to the reducer's input shaft. The other style is equipped with a bell shaped flange which allows sufficient room to accommodate a flexible motor coupling between the drive motor and the input shaft of the reducer. Unit is furnished in a range of sizes from 1.33 to 5.25 inches center distance; horsepower ratings range from 1/16 to 18 hp. **Ohio Gear Co.**, 1400 E. 179th St., Cleveland 10, Ohio.



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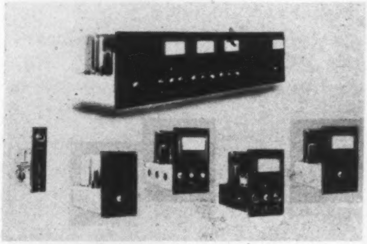


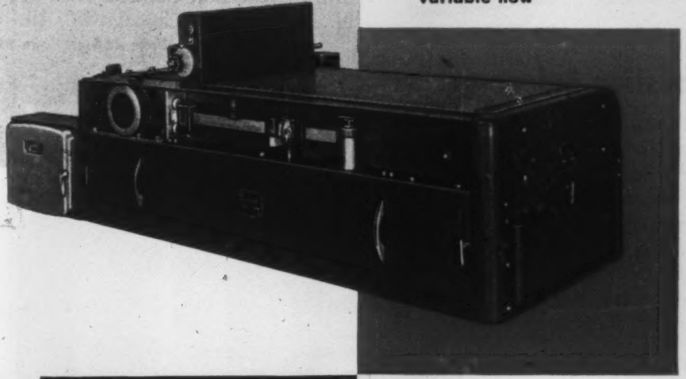
Gaging Modules

Line of electronic modules can be assembled into automatic high speed inspection systems for dimensional measurements such as hardness testing, self - compensating grinder controls, valve and spring testing, and inspection of ball and roller bearings, piston and piston pins, and crankshafts. The assembly is composed of five basic units—a master gage control, a thyratron unit, power supply, difference computer, and sum computer. The units can be used in different combinations or individually. A selection of nine gage heads with sensitivities that provide full scale read-

POSITIVE CONTROL OF MATERIALS IN MOTION B·I·F METERS FEEDERS CONTROLS

B-I-F BELT WEIGHER SOLVES PROCESS MEASUREMENT AND CONTROL PROBLEMS

- Checking production line output
- Checking in-plant inventory
- Weighing incoming and outgoing bulk shipments
- Evaluating process efficiency
- Density checking
- Batch weighing
- Signal producing for pacing additive materials proportional to a variable flow



CASE STUDY No. 1

B·I·F Omega **Pneu-Weigh Belt Weigher** checked production line output of 50 volumetric feeders to maintain critical limits . . . reduced plant downtime, lost man hours and production holdups!

Each feeder on proportioning line of a major formulator was putting out particular fraction of formula on continuous basis. Pneu-Weigh, installed at end of collector conveyor to "watchdog" operation through remotely located instrument, indicated less-than-expected output. A check revealed delivery rate of one volumetric feeder crtically lower than its limit. Result: over 100 tons of formulated product saved from being remade at considerable expense in plant time, man-hours, planning, removal of paper-bag packages, and subsequent resacking.

You'll find opportunities for cutting costs and improving efficiency in process feeding when you consult B-I-F — manufacturer of the most complete line of solid and liquid feeders and weighers.

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METERS • FEEDERS • CONTROLS / CONTINUOUS PROCESS ENGINEERING

Pneu-Weigh offers extremely high accuracies, wide ranges, capacities in compact, uncomplicated unit. Request Bulletin 36.20-1 for details. Write **B-I-F Industries, Inc., 527 Harris Avenue, Providence 1, R. I.**

Circle 693 on Page 19

ings of 0.005 to 0.020-inch are available. **Industrial & Automation Div., Radio Corp. of America**, 12605 Arnold Ave., Detroit 39, Mich.

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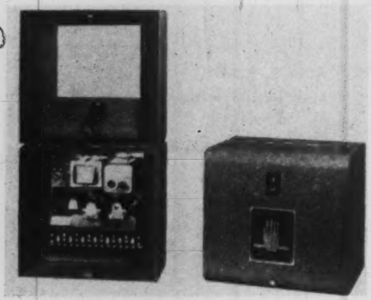

Combustion Safeguard

Combustion safeguard control is designed for the continuous supervision of gas-operated burners in ovens, furnaces, boilers, and other heating equipment. It prevents fires or explosions from build-up of combustible fuel mixtures in either single (shown) or multiburner installations. A plug-in subassembly contains the complete electronic circuit (one for each burner). In operation, if a flame failure or fault occurs at any burner position, the signal from the flame electrode to its corresponding subassembly is interrupted. This immediately breaks the circuit to the safety shut-off valve and stops fuel flow to all burners in the system.

Design of the unit, designated Protectofier, eliminates critical flame adjustments. Electrode can be immersed through the center of the flame without causing unstable operation. This design also permits use of a single electrode as both the igniter and the flame sensing unit. **Protection Controls Inc.**, 6000 N. Legett Ave., Chicago 46, Ill.

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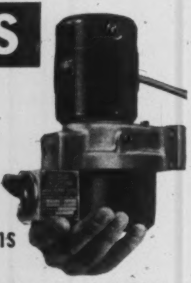

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BUILT-IN DIRECTIONAL CONTROL

Miniaturized in everything but power, Oil-Dyne pumps provide new economy and efficiency on standard hydraulic applications . . . make hydraulic actuation possible on applications never before feasible.

Oil-Dyne pumps simplify your design problems by eliminating external directional control valving . . . integral valving permits changing the direction of cylinder travel by simply reversing the motor. Pressures to 3,000 lbs. (5,000 lb. peaks); available with or without pressure switches and/or relief valves. Write for illustrated catalog.

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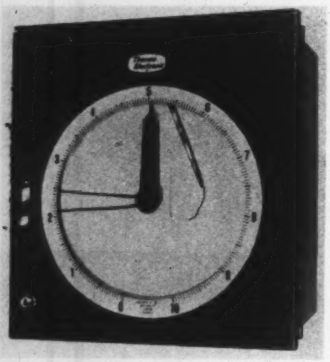
PUMPS • PRESSURE SWITCHES

CYLINDERS • VALVES • ACCESSORIES

OIL-DYNE INC.

2115E West Marquette Rd., Chicago 36, Ill.

Circle 694 on Page 19



Process Controller

Electronic indicating recorders and indicating recorder controllers are suitable for any process variable convertible to voltage or resistance change. Instrument accuracy is ±0.25 per cent of scale or 5 mu v; sensitivity is ±0.125 per cent and is unaffected by line voltage fluctuation, component, or amplifier tube change. Features of the units include a high-gain servo amplifier with a stability of ±1 mu v, power gain of 135 db, and a voltage gain of 100 million at rated load. Basic control action is two position (off-on) but it can be adapted to three position control to lag or lead the control set-point over the entire range of the instrument. Up to 6 alarm contacts can be provided for remote indication or external safety requirements. **Thermo Electric Co. Inc.**, Saddle Brook, N. J.

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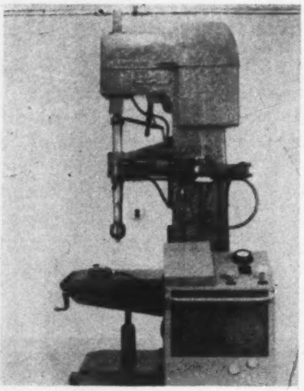

Drill Press Feed

Self-contained hydraulic feed is designed to automate heavy duty drill presses with capacities up to approximately $1\frac{1}{2}$-inch in steel. Feed consists of a heavy-duty transmission arm and a portable console that houses the control valves and hydraulic tank and pump. The hydraulic solenoid valve control system used provides a variable and adjustable approach speed, slowdown for work entry, return speed, and working thrust. **Beckett-Harcum Co. Inc.**, 985 W. Locust St., Wilmington, Ohio.

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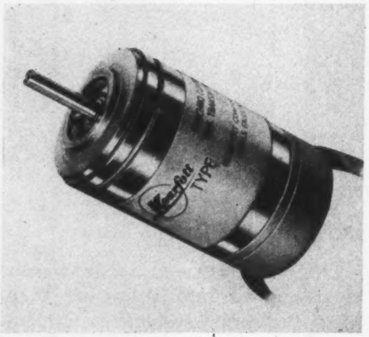

Servo System Components

Line of 60 cycle synchro transmitters, differentials, and control transformers is applicable in industrial servo systems for remote and automatic control of weighing operations, valve positions, liquid levels, and machine tool operations. The units, when used in conjunction with other components, can also regulate instrument dials, position potentiometers, and drive pen recorders. Stainless steel housing, shaft, and ball bearing construction and laminations of corrosion resistant nickel steel make the units adaptable for use in corrosive atmospheres. They have an operating temperature range of −54 to +125 C. **Kearfott Co. Inc.**, 1500 Main Ave., Clifton, N. J.

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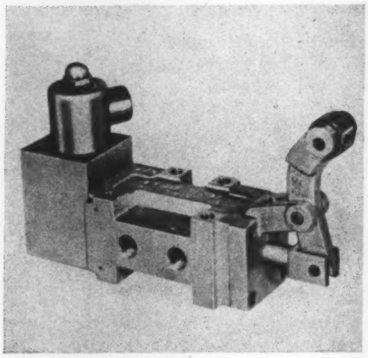

Spool Valve

Unit is constructed so that all operators for both ends of the body are interchangeable. Types of standard operators include single and double solenoid, hand, pedal, treadle, cam, bleeder, and remote air. The valve is designed so there is no spool wear as the spool contacts only the seals and the seals are not subject to extrusion or cutting. Unit is available in various types of neutral position spools. **Automatic Valve Co.**, 37415 Grand River, Farmington, Mich.

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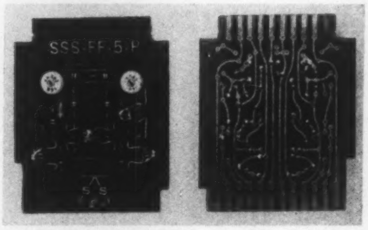
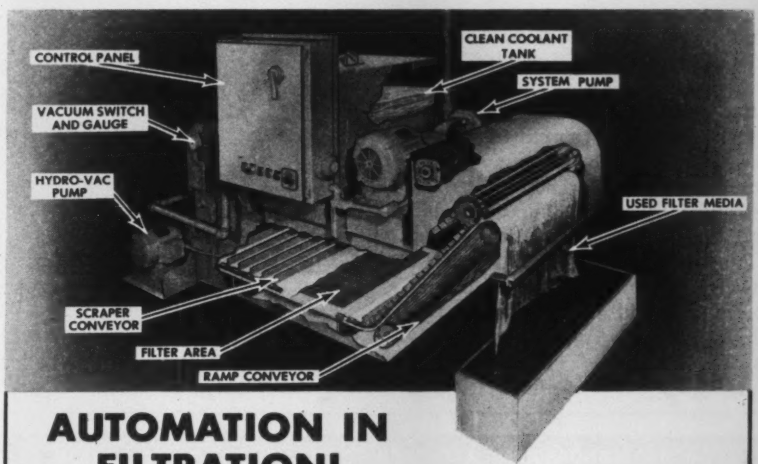


Logic Module

Line of transistorized plug-in control and logic modules is designed to permit checking the performance of the units in place, with-



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- Completely automatic operation
- Used with individual machines
- Compact — with low liquid inlet
- Low operating cost
- Fine degree of filtration
- Pressure and vacuum forces act on filter media
- Any coolant — any sludge

HYDROMATION FILTER CO.
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Circle 695 on Page 19

Step-up Production Line EFFICIENCY

Systems are available with speed reducing or increasing gears—with 12- or 24-hour disc charts or with 31-day strip-type charts.

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Use these precision recording devices anywhere that the control of speed, time and measurement is essential to the quality of your products. They tell you how fast and long a machine is used . . . let you measure output versus time . . . fit in perfectly with quality control and time study programs . . . graphically record operation of one machine or entire automated line to help you determine production peaks and valleys, and non-productive time.

Consult your nearby Wagner Sales Engineer, or write us about your production recording problem. Wagner engineers will tell you if Tachographs will help you increase production efficiency.

W160-1

Wagner Electric Corporation
6430 PLYMOUTH AVENUE, ST. LOUIS 33, MISSOURI

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out disturbing the normal operation of the circuit. Included in the line are: Flip-flops, gates, triggers, diode *And* and *Or* logic units, and power switching amplifiers. They are capable of accepting pulse repetition rates of 100,000 pulses per second. All printed circuit conductors are hard gold alloy plated. The module will fit a standard twelve terminal printed circuit connector. **Solid State Systems Inc.**, 5716 Camille Ave., Culver City, Calif.

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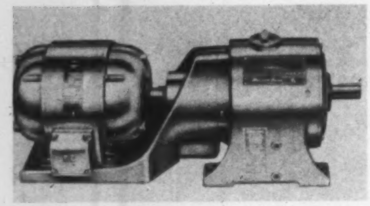
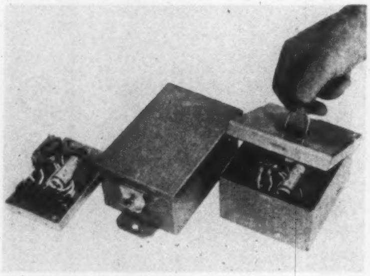


Gear Reducer

Available in ratings from ½ through 50 hp, motor gear reducer unit is applicable on conveyors, cranes, and automatic equipment, or on any machinery which requires a low-speed, high torque drive. Gear reduction ratios from rated motor speeds down to 250 rpm through 9 rpm output shaft speeds can be furnished in single, double, and triple reductions. Typical drive motors which are available are: Fluid-shaft, multi-speed, wound rotor slip ring, squirrel cage, crane hoist, and torque. **Reuland Electric Co.**, Alhambra, Calif.

Circle 462 on Page 19



Pulse Controller

Applicable with hydraulic-pneumatic machinery or counters, units are designed to shorten or extend the duration of an electrical impulse. Three models in the series designated PC-600 are available in three ranges of adjustability from 30 to 500 milliseconds. Controller features rapid recharge and lag characteristics. Only 15 milliseconds are required to recharge the system and there are only 5 milliseconds lag from start of input to start of output pulse. **Warco Industries Inc.**, 6625 Delmar Blvd., St. Louis, Mo.

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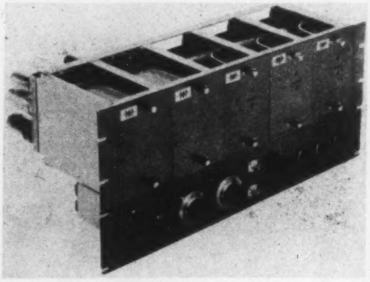


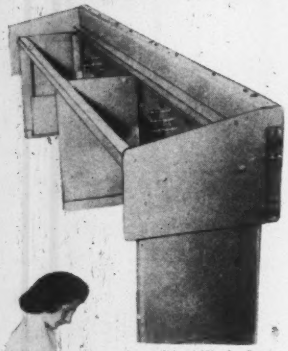
Voltage Comparator

Adaptable for automatic component testing, system check-out, or process monitoring, dc voltage com-

For the STANDARDIZED APPROACH TO STRAIGHT LINE PRODUCTION AND AUTOMATION . . . its the ALDEN WORK CENTER SYSTEM

Start with the basic Work Center frame with pre-wired and piped power channel, ready to receive work stations, plain or complete with mounted machines or job set ups.

Complete 4 position Work Center for semi-automatic production . . . All items shown are Alden Work Center Components.



4 position Work Center frame with power channel.

Individual machine Work Top mounted being slipped into position.

The Alden Work Center System permits a step by step approach to setting up an assembly line of any length, whether for manual or automatic manufacture with a range of modular "Building Block" components that provide for integrated manufacturing facilities . . . with complete flexibility for line changeover and rearrangement as desired . . .

INDUSTRY PROVED . . . Alden Work Center equipment is being used by such firms as General Electric, Raytheon, McGraw Edison, Hughes Aircraft, American Optical Co., Weston Electrical Instrument, Emerson Electric Co., etc. and used by nine leading Universities in Industrial Engineer training . . .

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Circle 697 on Page 19

ACRO WELDER MFG. CO.
MILWAUKEE
WELDING ENGINEERS
MACHINERY BUILDERS
ESTABLISHED 1936

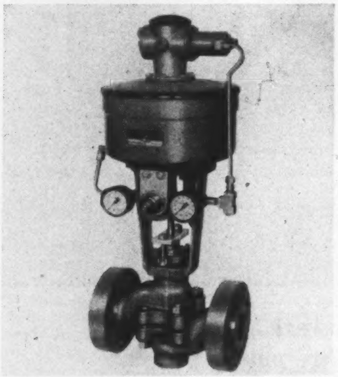
Circle 699 on Page 19

parator is designed for rapid and accurate *Go, No-Go* indication of dc voltage levels over a range from 1 mv to 100 v. The basic unit allows three voltage classifications—high, middle, low. Model DLI-205 features a self-contained Zener diode reference, a differential input giving 60 db common mode rejection at 60 cps, and 0.1 per cent absolute accuracy. The relay output can be used for visual indication, tape punch operation, or component selection. **Electro Precision Corp.**, P. O. Box 669, Arkadelphia, Ark.

Circle 464 on Page 19

Control Valve

Valve has a nodular iron body which has the corrosion resistance of gray cast iron. It has a higher temperature-pressure rating than cast iron or bronze. Valve is available in a straight-through design in sizes 3/4 through 6 inches, with 150-300# ASA raised face integral flanges. It is also available with screwed connections in sizes through 2 inches. **Conoflow Corp.**, Dept. D-8, 2100 Arch St., Philadelphia 3, Pa.



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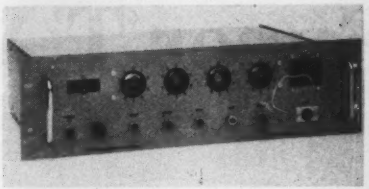
Preset Totalizer

Single or multiple preset totalizers are applicable for the automatic batching for packaging, multiple-lap coil winding, length cutting, and periodic thickness measurement. Accuracies to 100,000 events per second can be accomplished. In-line thumb-wheel switches provide adjustment of the desired or predetermined count totals. The use of transistors and cold-cathode tubes results in a reliable device with low power consumption. An optional batching register is available. **Iconix Inc.**, 945 Industrial Ave., Palo Alto, Calif.



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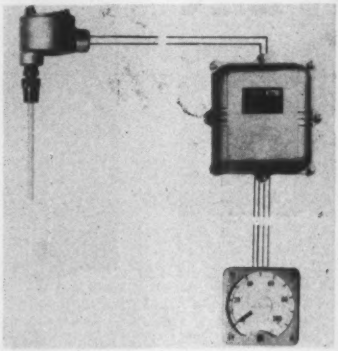

Level Measurement Unit

Instrument can detect, measure, and visually indicate media level changes, and is suitable for use with almost all liquids, slurries, powders, and granular solids. Unit consists of a probe, detector, transmitter, and indicator. In operation, the probe detects media level change as a change in capacitance, unbalancing a capacitance bridge. The out-of-balance condition is fed to the indicator via the transmitter as a dc signal proportional to the level change. The detector circuitry can operate in temperature environments ranging from −30 to +212 F. Teflon insulated probes can be operated from −325 to +350 F, and uninsulated probes will withstand temperatures up to 850 F. Features of Model 154 include two-step calibration, unrestricted cable length between the probe detector and transmitter unit, and high order linearity. **Aeronautical & Instrument Div., Robertshaw-Fulton Controls Co.**, Santa Ana Freeway at Euclid Ave., Anaheim, Calif.

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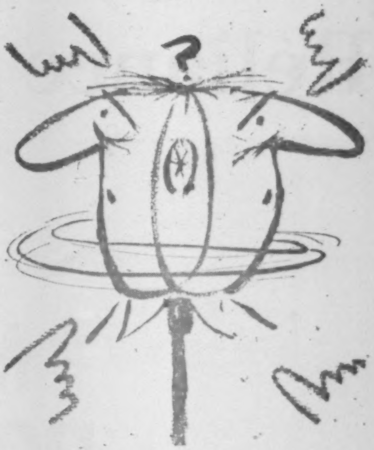
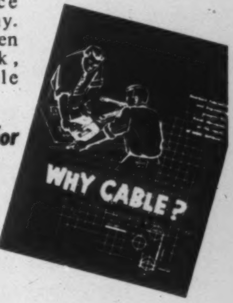


what do _you_ know about cable conveyors?

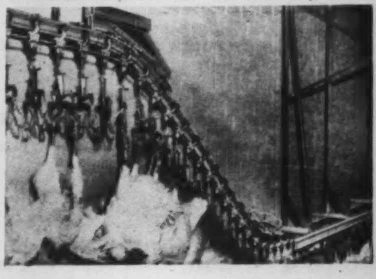
Don't be mislead, be well-read! Get all the facts on Dearborn Cable-Link. Find out about Cable-Link capacity—greater pay load per pound of drive than any other system. Find out about the versatility of Limber-Dip, about performance and economy. Production men who think, choose Cable Link!

Write now for Dearborn's WHY CABLE Brochure



Dearborn Cable-Link Conveyor

MANUFACTURED BY
DEARBORN FABRICATING & ENGINEERING CO.
19440 GLENDALE AVE. DETROIT 23, MICH.



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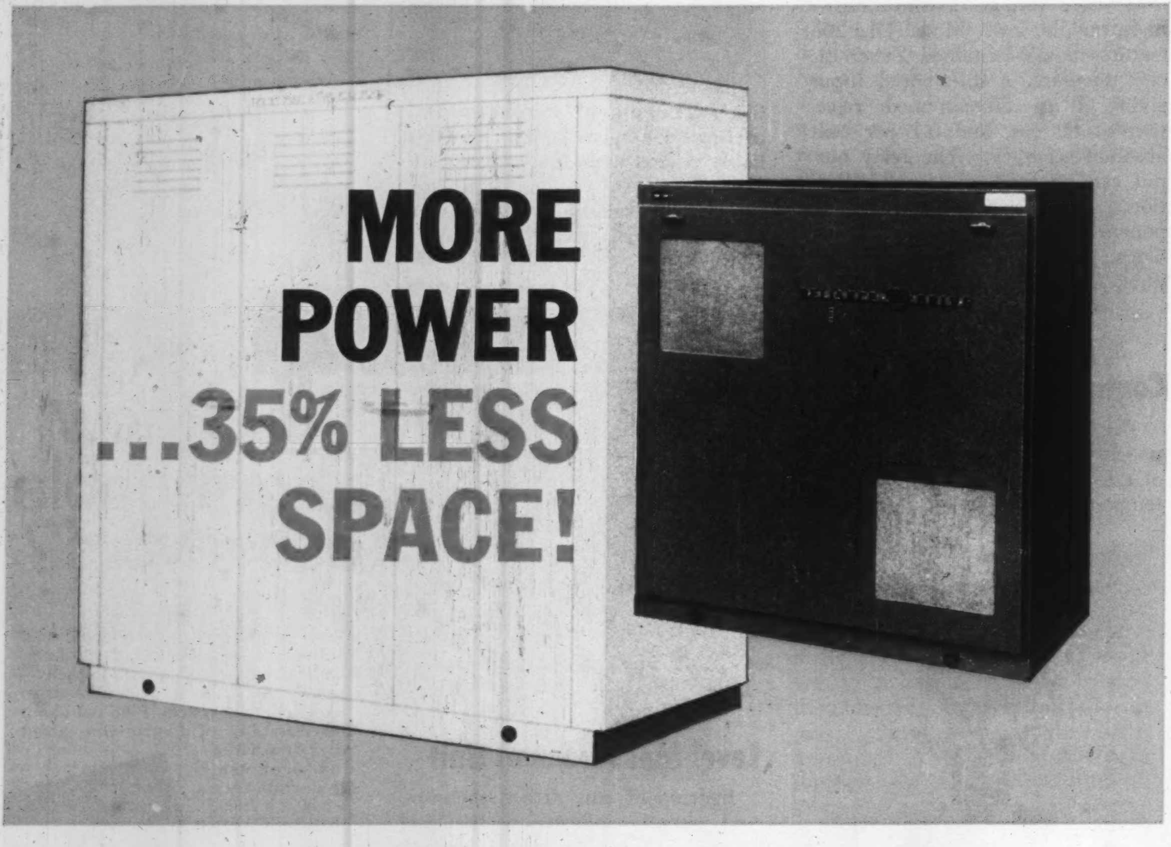
Reliance Super 'T' V★S Drives



Both of these control units are rated at 50 horsepower! Actually, the new, small Super 'T' V★S cabinet packs more punch!

LIKE the Reliance Super 'T' Drive Motor, new V★S power units utilize Class B insulation, permitting a more compact unit. 100% overloads of one minute duration are accomplished without failure! Advanced design of ventilation keeps control and power units cooler . . . another reason why smaller size is possible. And service life is substantially extended.

Matched system design of drive motor, power unit and controls produces a highly efficient, integrated drive—to give you a wide range of stepless, variable operating speeds from a-c. circuits.

Super 'T' V★S Drives are available for immediate delivery. Check your Reliance salesman for delivery schedules on the full line, 1—350 hp., Bulletin Number D-2506, has been prepared to give you complete information. Write for it.

D-1641

Product of the combined resources of Reliance Electric and Engineering Company and its Master and Reeves Divisions

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Canadian Division: Toronto, Ontario
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Duty Master A-c. Motors, Master Gearmotors, Reeves Drives, V★S Drives, Super 'T' D-c. Motors, Generators, Controls and Engineered Drive Systems.

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AUTOMATION

catalogs and literature

Latest automation information. For copies use card on page 19.

Spiral Conveyors

Jeffrey Mfg. Co., 956 N. Fourth St., Columbus 16, Ohio—56 page catalog—Data are contained in Catalog 951 on four types of spiral conveyors—helicoid, sectional flight, ribbon flight, and cast iron. A guide for laying out a standard conveyor is given, aided by schematic drawings of layouts. Notes are also included on how to select the proper conveyor for an application. One section of the book lists information on couplings and shaftings, hangers, trough ends, unit drives, thrust bearings, and accessories.

Circle 468 on Page 19

Infrared Photoelectric Control

Electronics Div., Cramer Controls Corp., Centerbrook, Conn.—4 page pamphlet—Instrument described in Bulletin 1B-1-959 operates by interruption of the direct beam. Applications for the unit—designated Infrabeam—include machine control, conveyor control, inspection or sorting, and liquid level control. Specifications and features of design and operation are noted.

Circle 469 on Page 19

Spray Painting

Ransburg Electro-Coating Corp., P. O. Box 23122, Indianapolis 23, Ind.—12 page booklet—"Spray Painting with the Electrostatic Hand Gun" is the title of booklet. Principle of the gun is explained. Gun uses electrostatic forces for atomizing and applying liquid coatings. Application photos show use of the gun for painting office furniture, water heater jackets, steel windows and doors, and gas air conditioners.

Circle 470 on Page 19

Computer Bibliography

Remington Rand Div., Sperry Rand Corp., 315 Park Ave. South, New York 10, N. Y.—54 page catalog—Annotated computer bibliography U-1806 is divided into three sections. The first section lists articles and books on the theory and operation of analog computers and converters, digital computers and converters, and peripheral equipment. The second section covers applications and what large scale computers can do in automation, business management and operations research, and engineering. The last section gives general background data and sources —lists indexes, periodicals, and glossaries.

Circle 471 on Page 19

Electronic Components

Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill.—528 page catalog—Over 40,000 electronic items are listed in 1960 catalog. Some of the items covered include: Tubes, transistors, semiconductors and diodes, voltage stabilizers, transformers, resistors, capacitors, potentiometers, rheostats, relays, switches, counters, program clocks, generators, and power supplies. Data are also given on high-fidelity equipment and electronic kits such as oscilloscopes, tube testers, capacity checkers, transistor and diode checkers.

Circle 472 on Page 19

Strip Tension Control

Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland 10, Ohio—4 page pamphlet—Results are given in Bulletin S11-1 on use of a strip tension control system in a steel mill to minimize strip breakage on three continuous annealing lines. Schematic drawing of the system is shown and a reproduction of a chart from one of the annealing lines is also included.

Circle 473 on Page 19

Rotary Pumps

Blackmer Pump Co., Grand Rapids 9, Mich.—6 page pamphlet—Rotary pumps in sizes from 3 through 8 inches, with ratings from 45 to 1900 gpm are described in Bulletin 170. Pump construction and materials are covered, and notes are given on pump selection, with a chart listing application characteristics. Other charts list performance data.

Circle 474 on Page 19

Open Back Inclinable Presses

Niagara Machine & Tool Works, 683 Northland Ave., Buffalo 11, N. Y.—24 page catalog—Data are contained in Bulletin 55 on line of open back inclinable presses available in 14 sizes with shaft diameters from 1¼ to 7½-inch and capacities from 5½ to 250 tons. Design and operation of the pneumatic friction clutch and brake is explained. Notes are included on accessories such as flywheel brake, power slide adjustment, air power inclining device, automatic centralized lubrication, and antiplugging switch.

Circle 475 on Page 19

Fluid Power Equipment

Oilgear Co., 1571A W. Pierce St., Milwaukee 4, Wis.—16 page booklet—Fluid power equipment is described in Bulletin 10051-H. This includes data on variable delivery, constant delivery, duplex, and automatic feed pumps; constant displacement, variable displacement, and reversible motors; and variable speed transmissions in sizes 33 to 2020. Pilot, directional, relief, and surge type valves are also covered, as are cylinders for 2000 and 3500 psi.

Circle 476 on Page 19

Hydraulic Cylinders

S-P Mfg. Corp., 30201 Aurora Rd., Cleveland 39, Ohio—12 page booklet—Data are contained in Catalog 117 on line of interchangeable high-pressure hydraulic cylinders for 2000 psi operation. A fold-out arrangement shows mounting diagrams, dimension charts, ordering information, and parts list. A method for determining oversized rod and stop tube applications is given, and notes point out the forces required for acceleration and deceleration.

Circle 477 on Page 19

Reinforced Tape & Card Stock

Dobeckmun Co., P. O. Box 6417, Cleveland 1, Ohio—4 page pamphlet—Data are given on reinforced tapes and punch card stock for numerical control, integrated data processing, automatic testing and checkout; and automatic processing control. Pamphlet describes punched tape for controlling the operation of many types of industrial machines using the photoelectric principle, mechanical control tape for office machines, and Duralam card stock for ledger sheets, rotary files, and index and tab file cards.

Circle 478 on Page 19

Magnetic Solenoid Valves

Magnatrol Valve Co., 60 Fifth Ave., Hawthorne, N. J.—20 page booklet—Line of electrically controlled magnetic solenoid valves is described. Included in the line are normally closed and normally open solenoid valves used for the control of water, oil, steam, air, solvents, gas, and chemicals. Cross-sectional diagrams show the valve function and operation. Specifications are listed in chart form so the valve needed for an application can be easily selected.

Circle 479 on Page 19

Handling Equipment

American MonoRail Co., 1111 E. 200th St., Euclid, Ohio—56 page catalog—Overhead handling systems consisting of tracks, cranes, trolleys, and switches for both heavy duty and light duty applications are outlined in Bulletin C-2. Numerous photographs of applications in various industries and processes are shown, and layout information is included.

Circle 480 on Page 19

Data System

Controls Div., Hagan Chemicals & Controls Inc., Hagan Bldg., Pittsburgh 30, Pa.—12 page booklet—Data system, designated Series 2000, is the subject of Bulletin MSP-161. Construction and operation of the basic modular chassis are outlined, including plug-in housings and pin-board arrangement for function programming. Data are given on functions of the equipment, such as inputs, dc amplification, analog-to-digital conversion, linearization, programming, integration, and computer control. Also included is a typical system block diagram.

Circle 481 on Page 19

Process Moisture Monitor

Analytical & Control Instrument Div., Consolidated Electrodynamics Corp., 360 Sierra Madre Villa, Pasadena, Calif.—4 page pamphlet—Model 26-310, a process moisture monitor for the continuous monitoring or control of gaseous streams is the subject of Bulletin 1845B. The explosion-proof analyzer is described, as is the remote control unit. A flow diagram is given as is a chart for converting the dew point temperature to ppm H_2O.

Circle 482 on Page 19

AC & DC Power System

Electric Products Co., 1725 Clarkstone Rd., Cleveland 12, Ohio—6 page pamphlet—Subject of Bulletin B21-200 is an inverter-diverter continuous ac and dc power system which is suitable for any application where uninterrupted service for either or both ac and dc loads is required. An oscillogram shows the transfer from normal to emergency operation caused by an undervoltage condition of the ac power supply. Other diagrams show normal and emergency operation.

Circle 483 on Page 19

Adjustable-Speed Drives

General Electric Co., Schenectady 5, N. Y.—8 page bulletin—Line of adjustable-speed drives, motors, and controls for calendering rubber, plastics, and similar materials is described in Bulletin GEA-6910. A planned program of drive modernization is discussed and some of the points covered include "Profitable Return", "Added Flexibility", and "Simplified Installation".

Circle 484 on Page 19

Machine Tool Control

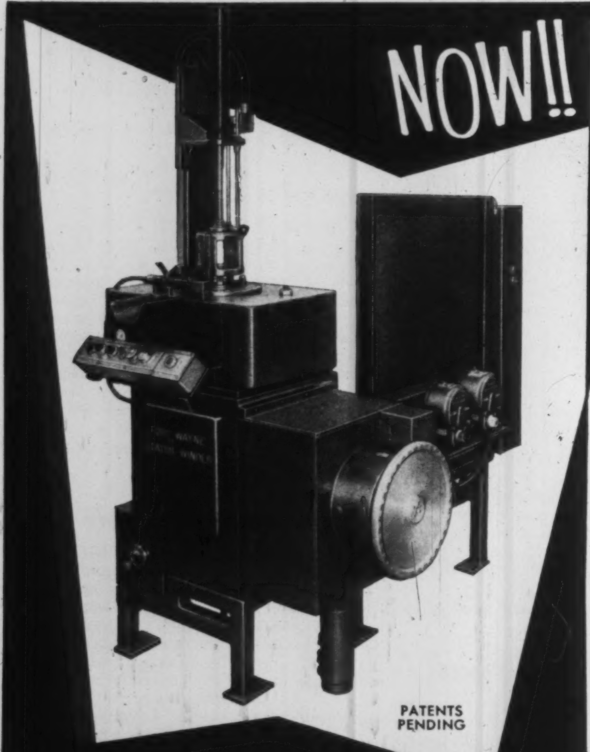
Industrial Systems Div., Hughes Products Group, Hughes Aircraft Co. International Airport Station, Los Angeles 45, Calif.—8 page bulletin—Subject of bulletin is Model 200 transistorized positioning control system which provides automatic positioning of a two-axis table using one-inch wide punched tape. The planning sheet and tape preparation are explained, and a typical work example is given and worked out. A block diagram helps explain the operation of the system.

Circle 485 on Page 19

Solid Woven Cotton Belting

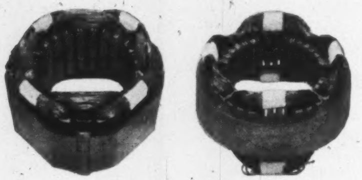
Woven Fabric Belting Manufacturers Assoc., 11 W. 42nd St., New York 36, N. Y.—16 page booklet—Various types of belting and how they are used are described. Applications are given for solid woven cotton belting, synthetic rubber impregnated belting, wax impregnated belting, and bituminous impregnated belting. Care and maintenance of the belting is covered and installation instructions are noted. Also included are numerous application photos.

Circle 486 on Page 19



Automatic simultaneous winding of 2 or 3 group concentric coil with

FORT WAYNE STATOR WINDER



*LOWEST MACHINE INVESTMENT PER UNIT PRODUCED

- Winding speed at 325 turns per minute.
- Preparation time ¼ minute . . . only 4 forms to place and remove.
- One operator can readily tend 2 or more machines.
- Completely automatic during winding cycle.
- Winds greater range of stator lengths.

*Production example—4-pole stator with 3-group concentric coil per pole at 125 turns per coil produces 88 stators per hour.

WRITE FOR COMPLETE DATA OR ARRANGE
TO VISIT OUR PLANT FOR DEMONSTRATION

FORT WAYNE TOOL, DIE & ENGINEERING CO.
1029 Goshen Road • Fort Wayne • Indiana, U.S.A.

Circle 702 on Page 19

Finishing Equipment

DeVilbiss Co., Toledo 1, Ohio—4 page pamphlet—Finishing system units are outlined in Bulletin F-325. This includes notes on spray guns, automatic spray coaters, flow and dip coaters, industrial ovens, air compressors, dust collectors, spray booths, industrial power washers, hot spray systems, paint tanks and pumps, hoses and connections, and phosphatizing systems.

Circle 487 on Page 19

Digital Magnetic Recording

Potter Instrument Co. Inc., Sunnyside Boulevard, Plainview, L. I., N. Y.—26 page report—Report entitled, "Digital Magnetic Recording with High Density Using Double Transition Method," describes a method of obtaining a 1500 bit per inch packing density for digital magnetic tape recording. Theoretical considerations with experimental test results are discussed. Information drop-out is examined to show performance in this regard which exceeds the accepted drop-out rates of existing lower density systems. Diagrams show the implementation of this technique.

Circle 488 on Page 19

Pushbutton Switch Assemblies

Micro Switch, Div., Minneapolis-Honeywell Regulator Co., Freeport, Ill.—8 page bulletin—Data sheet 150b describes three "one-shot" pushbutton switch assemblies which have a special circuit to produce one square wave pulse, regardless of operating speed. One assembly features a feather-light operating force for rapid-repeat keyboard control, another assembly features a positive touch-feedback to give the operator a feel of the switching action. Mounting diagrams, circuit diagrams, and graphs of typical output pulse curves are included.

Circle 489 on Page 19

Versatile Transformer

Superior Electric Co., Dept. TP, 83 Laurel St., Bristol, Conn.—8 page bulletin—Flexiformer, an ac voltage source and current transformer is described in Bulletin TP 659. It is a self-contained toroidal primary coil consisting of a strip-wound silicon steel core with a coil of 400 turns of #24 B & S gage copper wire. Secondary coil is wound by user as needed. Typical calculations are given and load voltages listed. Also included are operational diagrams.

Circle 490 on Page 19

Test Equipment

Theta Instrument Corp., 520 Victor St., Saddle Brook, N. J.—36 page catalog—Line of equipment which measures the electrical characteristics of control synchros, torque synchros, and computing resolvers is described. Details are given on the theory of operation and the operational sequence of all test set models. Specifications are also listed.

Circle 491 on Page 19

Chemical Cleaning

Chas. Pfizer & Co. Inc., 630 Flushing Ave., Brooklyn 6, N. Y.—17 page booklet—Data are given in Bulletin 102 on areas of chemical cleaning in which company products are used, either alone or as additives to improve existing methods and formulations. Reports are given on chemicals for cleaning powerplants, stainless steel, aluminum metal and aluminum alloys, aluminum etching, and cast iron-glass forming molds. Tables list corrosion rates.

Circle 492 on Page 19

Industrial Controls

General Controls Co., 801 Allen Ave., Glendale 1, Calif.—88 page catalog—Data are given on line of automatic valves, instruments, and accessories. These include automatic temperature, pressure, level, and flow controls; counters; switches; relays; transformers; actuators; combustion instrument controls; controller indicators; and pressure indicators. Schematic drawings and wiring diagrams are given.

Circle 493 on Page 19

Material Handling Equipment

Whiting Corp., 157th & Lathrop Avenue, Harvey, Ill.—16 page booklet—Material handling devices described in Bulletin 246 include overhead traveling cranes, monorail and crane systems, vacuum handling systems, and a road and rail freight car mover. Sketches show the design features, and installation photos show the adaptability of the equipment.

Circle 494 on Page 19

NOW...index tables

FOR MORE ECONOMICAL PRODUCTION ON THESE NEW

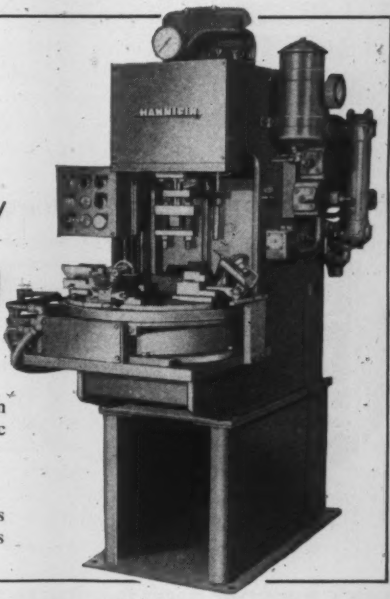
HANNIFIN

"FD" PRESSES

Heavy-duty open-gap production presses with Hannifin hydraulic index tables . . .

Available in all of these sizes:

2, 3, 4, 5 and 6-ton bench models
6, 8, 10, 12 and 15-ton floor models



WITH THESE FEATURES...
- Dual Safety Hand Lever Controls
- Dual Electric Push-Button Controls
- Adjustable Stroke Control
- Reverse on Pressure or Distance
- Full Automatic Cycling
- Hannifin High Speed Hydraulic Index Tables
- Reciprocating Hydraulic Slide Feeds

USE THEM FOR...
- Assembly Operations
- Riveting—Staking
- Forming—Stamping
- Trimming Die Castings
- Trimming Plastics
- Molding Semi-Conductors
- Preformed—Compacting

Call in your nearby Hannifin man—he's a trained production analyst—to prove how you can do more at lower cost with Hannifin presses. Or, write for our new Bulletin 132. It tells the whole story.

HANNIFIN COMPANY
541 South Wolf Road • Des Plaines, Illinois

A DIVISION OF PARKER-HANNIFIN CORPORATION

Circle 703 on Page 19

BARKSDALE AIR-SEAL* VALVES

LOW PRESSURE AIR TO 250 P.S.I.

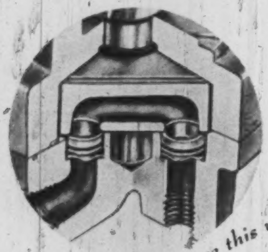
. . . over 200 different valves available.

Why so many different air valves?

Because air valve requirements vary with the method of actuation. A basic valve with interchangeable actuators cannot possibly meet ALL your specific applications without compromise. For example: A solenoid valve designed for speed would not have the stamina required of a manual or foot valve.

The Barksdale line of AIR-SEAL Valves has been designed with your requirements in mind. All our valves have been engineered for best performance from your point of view . . . for YOUR specific need, and not to make OUR job easier.

MANUAL and FOOT OPERATED "SHEAR-SEAL" VALVES



No oilers and filters needed — not critical to dirt and corrosion — made from non-corrosive materials.

Years of leakproof service — without constant maintenance — Self aligning "Shear-Seal" design compensates for normal wear.

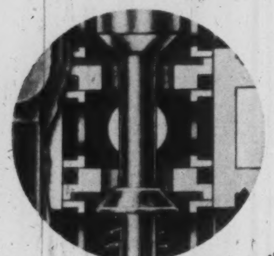
compare this with conventional

SPOOL or PLATE VALVES

Alignment is critical — dirt and corrosion cause sticking.

There is no compensation for normal wear — leakage increases with use.

SOLENOID-PILOT CRESCENT® (Self-aligning poppet) VALVES



Quick response (12 milliseconds) due to short travel of poppets and solenoid.

Tight sealing — self-aligning, self-scavenging design adjusts to normal wear — not critical to dirt and corrosion— non-corrosive materials throughout.

No coil burnout — heat dissipating "integral" design.

compare this with conventional

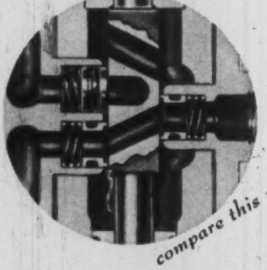
SPOOL VALVES

Slower response due to long spool travel.

Leakage increases with use — dirt and corrosion particles are ground-in between spool and seals—Sticking!

Overheating causes coil burnout — poor heat transfer of "unitized" design.

DIRECT-SOLENOID OPERATED "SHEAR-SEAL" VALVES



Leakproof for years of service — self-adjusting to wear.

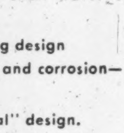
No coil burnout — because valve does not freeze up.

compare this with conventional

SPOOL VALVES

Dirt enters spool clearances — develops leaks — causes sticking — sticky valves are to blame for most solenoid burnout.

Write for Air Valve Catalog 9-AV



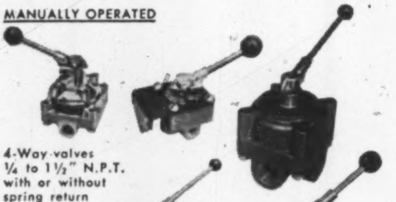
CONTROL VALVE DIVISION

barksdale valves

5125 ALCOA AVENUE • LOS ANGELES 58 • CALIFORNIA

**The air pressure is the sealing force . . . the higher the pressure, the tighter the seal.*

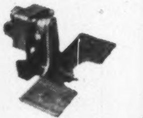
MANUALLY OPERATED



4-Way valves
¼ to 1½" N.P.T.
with or without
spring return

Shut-off valves
¼ to 1" N.P.T.
with or without
spring return

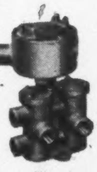
FOOT OPERATED



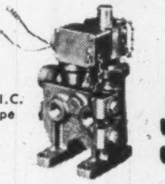
4-Way valves
¼, ⅜ and ½" N.P.T.
with or without
spring return

SOLENOID-PILOT

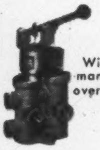
4-Way valves
¼ to ¾" N.P.T.
A.C. and D.C.
Standard

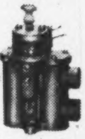


Explosion-proof



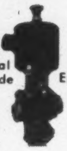
J.I.C. type





With manual override

3-Way valves
¼ to ¾" N.P.T.
A.C. and D.C.
Standard



With manual override

Explosion-proof

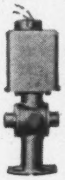
DIRECT SOLENOID

4-Way valves
¼, ⅜ and ½" N.P.T.
A.C. and D.C.
Standard

Explosion-proof

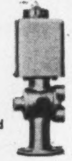
3-Way valves
¼, ⅜ and ½" N.P.T.
A.C. and D.C.
Standard

Explosion-proof



Shut-off valves
¼, ⅜ and ½" N.P.T.
A.C. and D.C. Standard

Explosion-proof



Diverter valves
¼, ⅜ and ½" N.P.T.
A.C. and D.C. Standard

Explosion-proof

AUTOMATION abstracts

AUTOMATION AND PEOPLE—TOMORROW'S STRENGTH

By C. H. THAYER
Vice President in Charge of Manufacturing
Sun Oil Co.
Philadelphia, Pa.

THROUGH greater precision in control, automation can contribute to longer runs, to higher throughputs, and to greater speed in shutdowns and startups. There are, of course, other benefits. Without question, automation offers enormous opportunities to effect needed reductions in operating cost. Through automation, we can substantially reduce the cost of utilities. We can eliminate the waste involved in re-running off-specification materials, and improve product quality at the same time. By automating older plants, we can make them competitive with newer ones and thus extend their life. Extending the life of plants is a vital matter in these days of high initial costs, high corporate taxes, and stretched-out amortization periods.

Broadly viewed, automation must be regarded as more than a means of reducing costs, however. It also must be recognized as a technological necessity. Our processes are growing increasingly complex and interdependent. Too much information must be received, too many related decisions made, and too many actions taken in too little time for the human mind and hand to master. The mind can no longer absorb all the necessary information and make all the necessary calculations fast enough by the time a decision is needed.

Farther to Go

Although we have come a long way in instrumentation and automation in our refineries, we still have much to learn. For example, it is curious to me that I can control my TV set with a gadget that operates without any direct interconnection, and yet a highly instrumented refining unit requires a tremendous, and needless to say expensive, maze of wires and air lines to link the various parts of the control system. One little fire with the destruction of your instrument connectors and leads and you are out of business for a week or a month. Surely the computer control of the future will issue its orders directly to the final control elements by a wireless and pipeless system, such as a microwave carrier or directed ultrasonic beam. Perhaps we need to speed up our efforts to develop single-purpose mechanical or electronic brains which combine sensing, computing, and control functions in a compact housing attached directly to the unit being controlled.

It is unfortunate that automation is popularly regarded as a process whose all-consuming purpose is to replace people with machines. I have sought to point out that automation is a necessary next-step that promises many operating savings. These savings are greater than the reduction in wage costs that automation may permit. Yet it is also true that unless the personnel organization of a plant can be designed to match the new circumstances of automated control, the incentive to automate will be sharply reduced. In other words, unless wage costs per unit of output can be cut, the other savings provided by automation will be offset to such a degree as to discourage the investment in automation. This would be to the detriment, I might add, not only of the organization but of its employees and the public.

I have previously made the point that while union leaders have not attacked automation *per se*, some of them have attacked just about everything that must be done to make automation economically desirable. The current difficulty in the steel industry over the work rules clause of the contract tends to validate that statement. The impasse that has been created, incidentally, directly contradicts a fine statement on the gains to be made by automation in a booklet published by the A.F.L.-CIO. But I must add, at the same time, that for much of the cleavage between employees and management in industry, management has only itself to blame. We have all been so busy with the economics, the financing, the development of our physical installations and their efficient operation, that we have often failed to take employees into our full confidence.

Sure, we looked out for employee safety and health; we were concerned with vacation plans, insurance plans, and other benefits in ever-increasing abundance; but we neglected minds and hearts that wanted the respect of frank talk, the challenge of participation in overcoming obstacles, and the pride of being on the team. We should not be surprised that so many employees are torn today by divided loyalties and that management finds its leadership challenged. Or that mere coexistence is regrettably the rule in relationships between employees and management in far too many organizations.

I'm happy to say I believe I see signs of opportunity for a change on the horizon. My belief is based in the essential intelligence of the American workman, who is becoming more knowledgeable all the time. The men who operate tomorrow's refineries will have a deeper grounding in economics, a keener ability to separate fact from falsehood, sincerity from soft soap, and a higher resistance to being led around by the nose—by anyone.

I have suggested that the contributions of petroleum to better living in America in the future will be related to our continuing ability to keep prices down and wages up. To accomplish this dual objective, we need now to apply new ideas and new techniques to the reduction of unit costs. But I want to emphasize that as we develop the new methods, we must develop also, with equal care, our plans for the people who will be most affected by the cost-cutting, labor-saving devices and techniques. We must concern ourselves in advance with re-training from skills that will no longer be needed to skills that will be needed; recognize our responsibility to employees as individual human beings; and take no action that will further divide our houses.

From a talk entitled "Plants, Processes, and People—Tomorrow" presented at the Annual Meeting of the American Society of Mechanical Engineers, Atlantic City, N. J., December 1959.

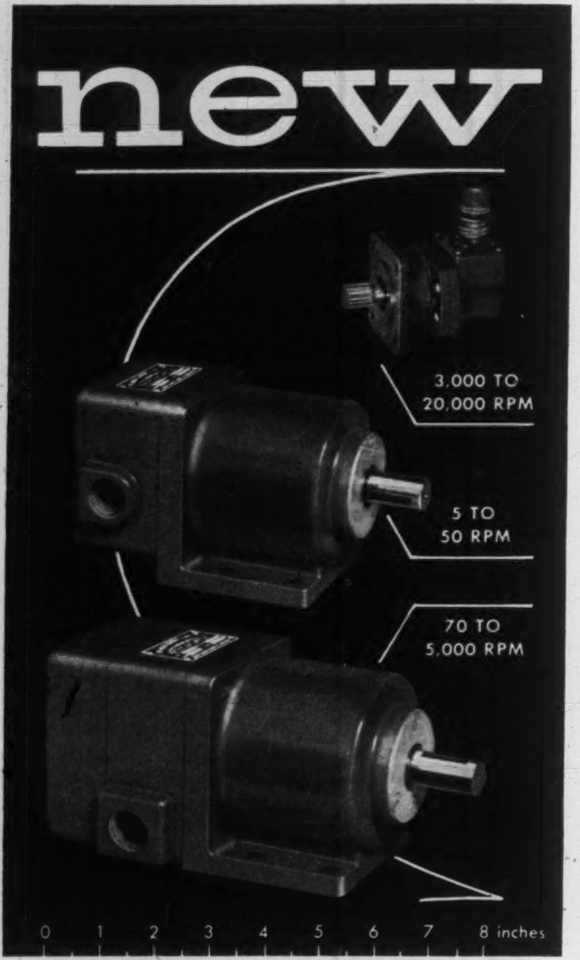
CONTINUOUS PRODUCTIVITY IMPROVEMENT

By G. W. JERNSTEDT
Manager, Manufacturing Planning
Westinghouse Electric Corp.
Pittsburgh, Pa.

THE AVERAGE industrial manufacturing plant must secure an increase in productivity between 3 and 5 per cent each year just to hold its own. Productivity, as used here, is the ratio between physical output and total input of capital and human effort. This productivity increase will not compensate for increases in wages and materials which have been rising at a faster rate; nor will it provide additional funds for major product improvements, research, emergencies (such as low volume periods), or capital for rebuilding and expansion. This means but one thing: The successful organization will have to better a 5 per cent annual productivity increase.

At Westinghouse, a two-fold objective has been established to determine specific goals for productivity improvement and to keep expansion of physical facilities in line with future requirements. Plans for the future presuppose that the output of an existing plant can be increased 3 per cent per year by continuous planning, normal improvements in equipment, and better use of materials. This 3 per cent per year is a base line—not only for increased capacity, but for increased productivity as well. It is obtained with existing organizations and without any major changes in products or facilities. Improvements in productivity above the 3 per cent level must be obtained through major changes in products, manufacturing methods, facilities, or a combination of these. To secure these improvements, a plant has to be organized and equipped to continuously and aggressively develop and put into operation more and more comprehensive projects. The pace is increasing constantly. Even large corporations will not be immune to failure.

Responsibility for continual improvement in produc-



SPEED-RESPONSIVE SWITCHES

These control-circuit switches, depending on the type, are responsive to changes in speed from 1¾ to 20,000 rpm and direction of rotation. Contact adjustment may be made while running. Rugged construction, several contact arrangements and consistent accuracy make them suitable for applications such as zero-speed or plugging switches on machine tools, as over-speed or under-speed switches on rotating machines and drives of all types, as anti-plugging switches on machinery with inertia loads and as interlocking switches for conveyor systems. Ask for descriptive Bulletins 2210, 2220 and 2230.

Designs for special applications have been manufactured. Let us know your specifications.

THE EUCLID ELECTRIC & MFG. CO.
MADISON, OHIO

THE EUCLID ELECTRIC
EUCLID
AND MFG CO., MADISON, O.

Circle 705 on Page 19

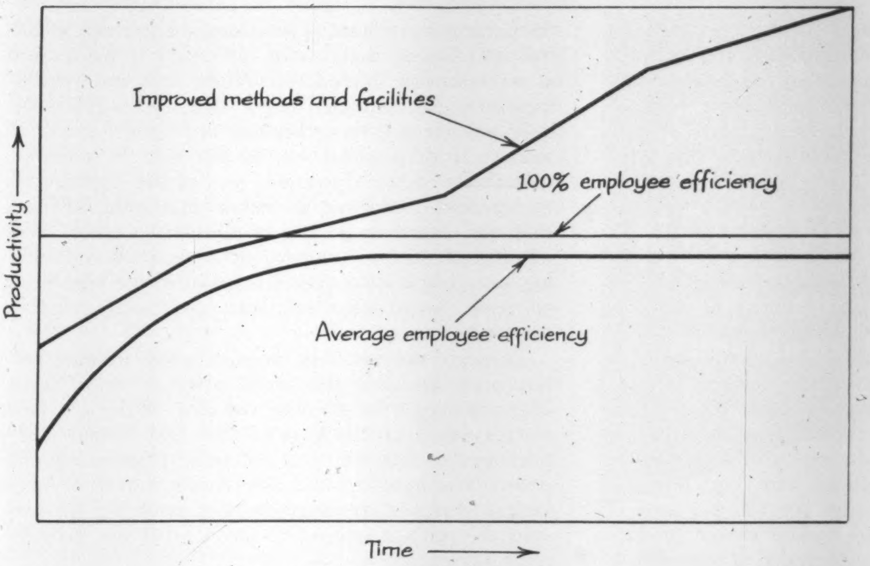


Fig. 1—Graphical representation indicates why most of productivity increases should be sought through improved methods and facilities. As time passes and increases are attained, employee efficiency approaches a maximum productivity for a given method. Methods improvements can easily raise the productivity level.

tivity starts with the top management of a plant and extends downward, with no one function having all the responsibility. For example, Engineering, Sales, and Manufacturing all play a part. Since Manufacturing actually produces and ships the products, its contribution will be examined in detail.

Manufacturing may be separated functionally into three principal areas: Operations, Control, and Planning. Operations covers the line personnel such as the foreman, superintendent, and others who actually make the products. Control includes the regulatory functions of production, inventory, quality, and labor standards. People in these activities are responsible for most of the paperwork controls to produce the products. The

the best 4-way 1/4" single pilot valve made costs $21.00 at

ALKON

a dollar more gets you the best double pilot valve.

And the quality, like the price, is unbeatable. Working and sealing surfaces are so hard they won't wear out—ever! Alkon single and double pilot valves operate at *vacuum* to 200 p.s.i. Like all Alkon valves they are sub-base mounted at no extra cost!

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200 Central Ave., Hawthorne, N. J.

ALKON

last group is Planning. Here are all the professional people required to plan processes, tooling, and facilities necessary to enable the line personnel to produce products according to predetermined requirements. Each of these three functions of Manufacturing plays a vital part in establishing continual productivity improvement.

Operations

The contribution of the line organization will be examined first, since it has the majority of the personnel. Where should we obtain improvements in productivity—from people, methods, or both? From a manpower standpoint, with a given method productivity per worker has a definite ceiling at 100 per cent efficiency, using the term "efficiency" to describe the ratio between number of units produced and number of units which can be produced with high-level effort during eight hours per day (or 100 per cent of the available time). Even top workers cannot produce above this level for any sustained period of time, *Fig.* 1. To secure a productivity improvement of 5 or even 3 per cent per year from this source would be impossible. Even to obtain 95 per cent efficiency on a continuous basis would require not only unique ability but also unusual effort on the part of both employees and their supervisors. It has been our experience that most of our productivity increases are obtained through improved methods rather than by unusual efforts from workers.

With the Operations part of the job separated from the Control and Planning functions, the foreman spends full time seeing that worker efficiency is maintained at a reasonably high level. While it is not possible to sustain greater than 100 per cent worker efficiency, it is possible for the efficiency of a given group of workers to drop well below 90 per cent. It is the responsibility of the Operations part of the organization to see that it doesn't go below that point. Factors that can contribute to loss of efficiency include: Poor selection of employees; inadequate orientation and training; poor employee environment; inadequate scheduling of work; inept labor relations; and uninformed or overworked supervisors.

Through the last few decades, good improvement has been made in the productivity of direct labor. The tools and the training required to do this have been available in the form of time and motion study, micromotion analysis, and industrial engineering programs. The indirect labor area does not have as many logical tools and training programs available. As a result, the ratio of indirect to direct labor has been increasing constantly.

At Westinghouse, indirect labor operates on a managed cost basis. Thus, any increase or decrease in indirect labor costs is traceable to a decision of management and not to an operational requirement to produce the product. In the past, when activity increased, indirect labor costs would rise. But as the volume decreased, these costs did not come down proportionately. Failure of indirect costs to follow volume requirements seriously impeded efforts to maintain a

Something **NEW** *you should know about!*

FEEDMATIC-DETROIT AUTOMATED EQUIPMENT

Now, you can speed small parts production and cut costs with new Feedmatic electrically controlled machines. These units automatically and continuously feed, inspect, segregate or assemble parts at greater efficiency . . . reduce handling costs on high volume operations. Use Feedmatic automated machines separately or for high speed delivery to machine tools, heat treating furnaces or final assembly areas.

If your operation involves the manufacture or processing of parts in volume quantities, it will pay you to investigate the cost saving advantages of Feedmatic automated equipment. *Send us your problem today!*

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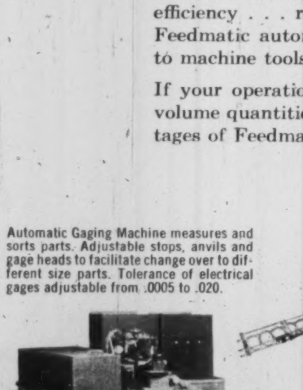
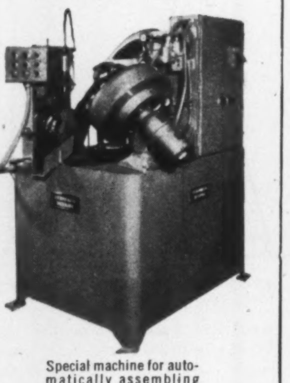
Automatic Gaging Machine measures and sorts parts. Adjustable stops, anvils and gage heads to facilitate change over to different size parts. Tolerance of electrical gages adjustable from .0005 to .020.



Model 12F Floor Hopper. Parts storage capacity, 12 cubic feet. For automatic feeding of larger parts.

Rotary hopper unit. Fast, efficient parts feeding. Available in sizes from 8" to 24". Feed tracks engineered to meet specific job conditions.

Special machine for automatically assembling automotive components.



reasonable profit level. One of the steps taken to control indirect labor costs was to establish a standard volume. This is the smallest annual volume expected during a 3-year period. All activities of an expense nature (managed costs) are geared to the standard volume, and therefore are not affected by fluctuations of actual volume.

Using the standard volume level, the foreman forecasts and controls expenses such as machine maintenance, defective material, tool maintenance, and other shop accounts. Trouble spots are quickly indicated and over-all performance continually monitored. Improvements are scheduled to result in an increasing level of productivity in the indirect labor area.

Although an individual worker has limited opportunity to improve his personal efficiency, much can be accomplished with the manual portions of jobs by the Industrial Engineering group. Progressive refinement of line balancing—employing new techniques and more sophisticated equipment such as computers—are opening new avenues to improved productivity. Realignment of job content—even to the extent of adding operations to reduce over-all costs—is producing better efficiencies.

Control

The Control group is responsible for control of inventories and the scheduling of materials flow. An example of improvement here is the gradual reduction of storerooms. As manufacturing lines become more progressive, it is often advantageous to store material right on the line, and control inventory by the work flow. Much paperwork is eliminated this way. Two other developments that have helped reduce paperwork are mechanized office equipment and computers. In one division that uses a computer, a design engineer feeds critical design dimensions into the machine and the final product design emerges as a preprinted drawing. Raw material requirements, scheduling data, and time values are supplied as byproducts. Here, the computer or other automatic office equipment does the routine portion of common denominator jobs.

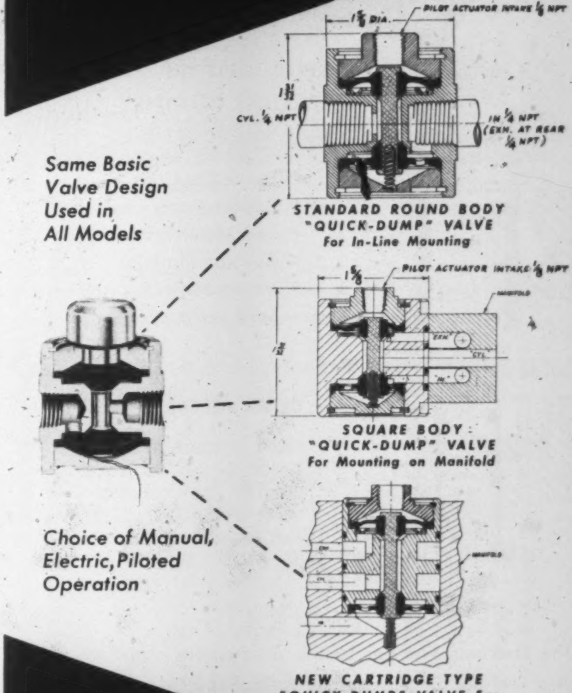
One of the benefits of this integrated data processing is increased accuracy in processing of information. We find that the elimination of human errors in pricing will often pay for the complete electronic equipment for data processing integration.

Planning

In order to secure continuous improvements in methods and facilities, a permanent Manufacturing Planning Department has been established in every Manufacturing Division. The functions assigned to this department are listed in Table 1. The manufacturing planning group includes all the professional people necessary to carry out the over-all job of planning the facilities and methods for a manufacturing unit. The individual groups in the planning department consult with representatives from the operating and control groups, as well as outside suppliers. However, it is their responsibility to improve the way jobs are done.

New plant planning probably best explains how the

Versatile Humphrey
"Quick-Dump"
Valves Provide
NEW FLEXIBILITY
In Designing
Pneumatic Controls


1⅝ DIA.
PILOT ACTUATOR INTAKE ⅛ NPT
1 31/32
CYL. ¼ NPT
IN ¼ NPT (EXH. AT REAR ¼ NPT)
1⅝
PILOT ACTUATOR INTAKE ⅛ NPT
MANIFOLD
EXH
CYL
IN
MANIFOLD

Same Basic
Valve Design
Used in
All Models

STANDARD ROUND BODY
"QUICK-DUMP" VALVE
For In-Line Mounting

SQUARE BODY
"QUICK-DUMP" VALVE
For Mounting on Manifold

Choice of Manual,
Electric, Piloted
Operation

NEW CARTRIDGE TYPE
"QUICK-DUMP" VALVE For
Inserting Internally in Manifold

The basic "Quick-Dump" Valve, small in size, large in capacity, lightning-fast in operation, permits endless variations in body type, methods of mounting, methods of actuating.

There are round, square, cartridge styles; 2-way, 3-way, 4-way; ⅛", ¼", ½" sizes; manual, electric, or pilot-operated. All valve air, oil, water, other liquids, gases to 125 psi. Also vacuum.

Utilizing the flexibility of "Quick-Dump" Valves, Humphrey engineers are producing a continuous flow of new pneumatic controls, both for plant processing and OEM applications.

Your control problem may also lend itself to ready solution through the use of "Quick-Dumps." Consult the Humphrey engineering department.

Complete
Line of
Standard
"Quick-Dumps"

MANUAL

ELECTRIC

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Humphrey PRODUCTS DIV.

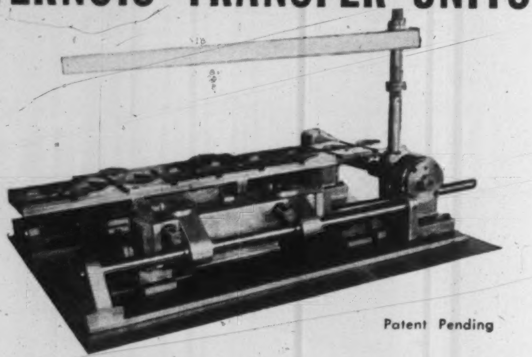
General Gas Light Co.
KALAMAZOO, MICHIGAN

Specialists in
Pneumatic Devices

Circle 707 on Page 19

Get Efficient Automation with

LIVERNOIS TRANSFER UNITS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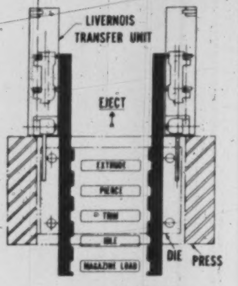
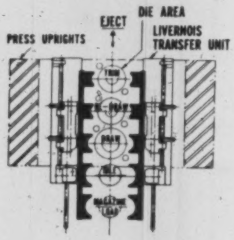




HERE'S WHAT THE LIVERNOIS TRANSFER UNIT WILL DO FOR YOU:

- Lower Die Costs
- Reduce Labor Cost
- Less Maintenance
- Save on Material
- Increases Production—with fewer presses

OTHER FEATURES:

NEAT — COMPACT — FOOLPROOF — ADJUSTABLE — RUGGED CONSTRUCTION — LIGHT WEIGHT — FLOATS ON BALL BEARINGS.

The Livernois Transfer Unit is a completely mechanical device without any electrical, pneumatic or hydraulic aids. Automation is attained entirely by movement of the rams.

Ideal for machining application such as drilling, tapping, chamfering and deburring by actuating unit with air or hydraulics.

Ten different models and sizes. Engineered to fit any press. Can be used from press to press, from year to year. Readily and quickly adjusted for transfer distance and finger in and out movement.

CR. 8-0200

LIVERNOIS ENGINEERING CO.

25200 Trowbridge, Dearborn, Michigan

planning function operates. A parallel planning team is separated from an existing activity presently producing the product. This planning team does not concern itself with the day-to-day job of planning for the operating division; it devotes full time to the job of planning the new plant. The team has complete freedom to propose entirely new methods of manufacturing. Of course, these methods must be evaluated by the Operating, Engineering and other Manufacturing Departments. When considering a new plant, Control and Operations are also included on the team.

Planning teams are assigned 3 to 4 years in advance of the time we expect a major new plant to start operations. In order to justify the tremendous expense involved in providing a new facility, a major improvement in productivity must be secured. Where the planning team has been particularly aggressive and imaginative in establishing new methods in the new plant, we have secured improvements in productivity in the order of 20 per cent.

In order to reduce the start-up time in a new plant and to assure productivity improvement, we generally transfer the planning team in part or whole to start the plant up. The normal continuous planning improvement must not stop, even during the first year of operation in a brand new plant.

Table 1—Typical Functions of a Manufacturing Planning Department

1. Manufacturing Engineering
2. Manufacturing or Process Development Laboratory
3. Plant Layout
4. Materials Handling
5. Tool and/or Machine Design
6. Appropriations and Budget
7. Methods Engineering

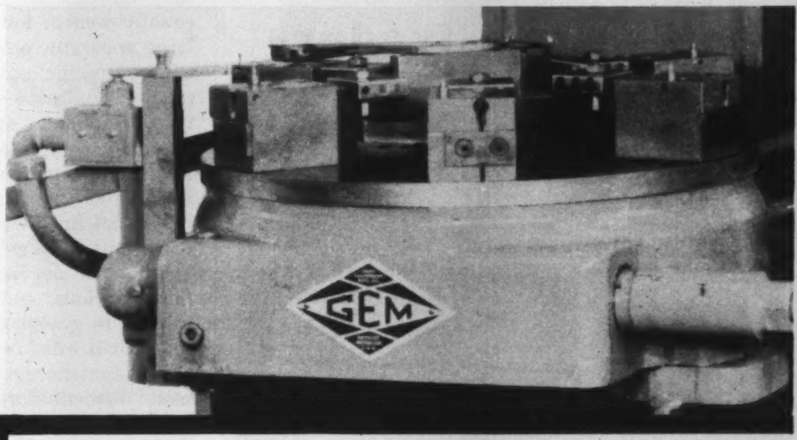
We anticipate the trend will be fewer new plants during the next seven year period than during the past seven year period. However, we still expect to secure the same productivity improvement across the board. How will we do this? We will look to our existing plants. We will apply somewhat the same planning techniques. We will use the existing planning team and in some cases even separate a smaller planning team just as we do for a new plant. We will study entirely new methods of manufacture. We will make major changes in product design and manufacturing methods to reduce our manufacturing costs and to improve the product.

We expect to spend the same amount of money—and probably more than we did in planning and building new plants—for modernizing our existing plants. We find there are advantages in modernization. For example, we do not have to establish a new labor force; do not have the high start-up costs of a new plant; can schedule changes department by department and keep production flowing. In every case, modernization reduces the cubic footage required to manufacture the product, thereby releasing floor space for increased volume when and if it occurs. In order to increase our productivity beyond the bare minimum required to hold our own, it is not necessary to build a new

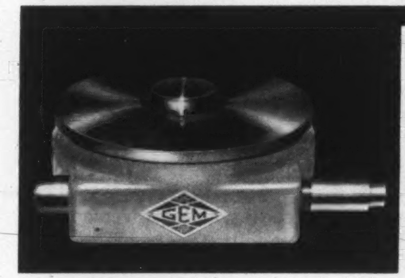
precision indexing to ±0.001"

. . . WITH GEM-17 DIAL INDEX TABLE!

FAST	Geneva motion smoothly positions in speeds up to ½ sec.
RUGGED	1000 lb. work load with solid anvil capacity of 30 tons.
POSITIVE LOCK	Bolt in Geneva slot cammed both in and out given positive locking.
POWER	Comes complete with rotary air motor, solenoid valve with limit switch (fluid or electric motors available).
NUMBER OF STATIONS	6, 8 or 12 standard, 3 and 4 skip.
SIZE AND WEIGHT	200 lbs. complete with 17" dia. table (plates up to 36" available).



GEM-17 mounted on GEM ATP-6, 6 ton toggle press with standard GEM base.



gem

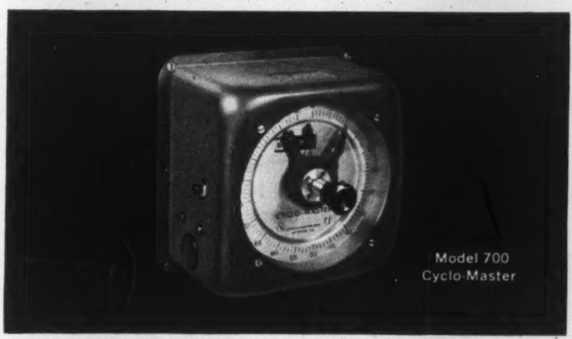
Geneva Motion GEM-17 Indexing Table standardizes automation on your assembly and machining operation . . . drilling, tapping, riveting, spinning, staking, knurling, chamfering, welding, screwdriving, stud driving and gaging to the speed and accuracy required. Gray's complete engineering staff can adapt the table to your work problem.

Send for Bulletin DI-17 and complete information.

GRAY equipment company
13600 Ford Road • Dearborn, Mich. • Telephone: Tiffany 6-7573

Circle 709 on Page 19

FOR ONE COUNT SWITCHING
ONE CYCLE SWITCHING
DIFFERENTIAL COUNTING



Model 700 Cyclo-Master

use the new

Cyclo-Master

continuous cycling preset counter and controller

- Counts electric impulses at speeds up to 1000 counts per minute
- Can be preset to any cycle from 1 to 100 counts
- Recycles without pause or hesitation
- Ideal for automatic control of machines and processes

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COUNTER and CONTROL CORPORATION
4511 WEST BROWN DEER ROAD • MILWAUKEE 18, WISCONSIN

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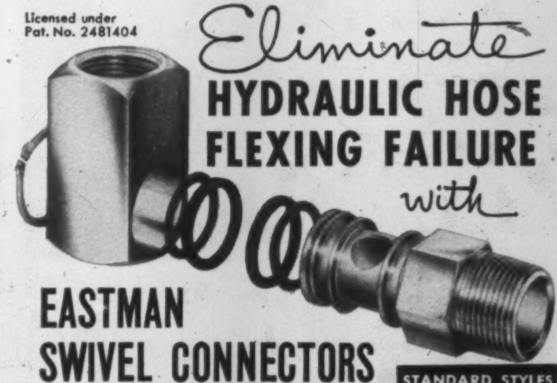
Eliminate HYDRAULIC HOSE FLEXING FAILURE with



EASTMAN SWIVEL CONNECTORS

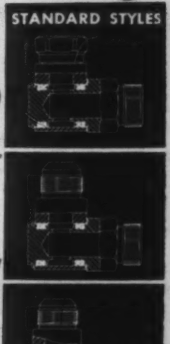
for industrial applications

Makes flexing installations on industrial and machine tool applications the strongest link in your hydraulic system. Permits full rotation, friction-free under pressures up to 5000 psi.

Design assures "balanced" fluid flow at required pressure, at any angle. Double seals at each end of stem balance fluid pressure, causing body to "float" on stem, free of end load, at low torque.

Various combinations of stems can be interchanged with any body style. Sizes—½" through 1½".

WRITE for Eastman Technical Bulletins Nos. 100 and 200 on High, Medium and Low Pressure Hydraulic Hose Assemblies.



Eastman MFG. CO.
Dept. A-1, Manitowoc, Wis.

Circle 711 on Page 19

HOPPERAL

something NEW in small parts feeders

SINGLE TRACK

Orients and releases one or more parts in a single, smooth, sliding motion. Lifts part to track with a minimum of vibration or tumbling action. Fast, versatile, self-contained

MULTIPLE TRACK

Available with any number of tracks to feed parts to assemblies or other operations where a large quantity of parts is required simultaneously. Can be partitioned and supplied with properly designed tracks to feed unlike parts

HOPPERAL DRIVER

Can be equipped to drive small nails, drive screws, pins, rivets, roll pins and a multitude of similar parts. Will feed small parts for assembly requiring staking, press fitting, peening and riveting

Write for further information about these automated feeders and assembly machines.

HABERSTUMP-HARRIS, INC.
10463 Northlawn Avenue • Detroit 4, Mich.

plant. It is necessary, however, to have a permanent organization devoting full time to initiating projects of sufficient scope to do an effective and continuous job. In carrying out the day-to-day improvement, the Manufacturing Planning Department functions equally well in low activity or high activity plants, in large apparatus or small product manufacture.

One specific area where we have carried out the required improvement in productivity has been mechanized equipment and automation. We have upgraded automatic equipment in lamp manufacture from a thousand lamps per hour to three thousand lamps per hour, and, we are planning still higher rates. On individual lines we have increased the production rate of various consumer products as much as 100 per cent in the last ten years. These changes have all been fairly obvious, and have been fortified with the high interest in automation. In job shop operations we have found it is even possible to afford some relatively high cost automatic equipment where we can find a common denominator operation. Preparing and joining leads for electronic components and testing these components on automatic equipment that is flexible and tape programmed are two examples. Suppliers are now looking at automatic equipment which has as its feature maximum flexibility.

Additional Benefits

Having as an objective a continual improvement in productivity produces some additional benefits. For example, where a poor planning job has been done the labor force suffers from higher peaks and frequent reduced levels of production. In general, an unstable operation results. Planning for and being able to count on increases in productivity without providing excess capacity (to meet anticipated peaks in load) enables the operating division to earn a profit even at reduced volume.

Occasionally, we find a competitor suddenly dropping the price of a product. Assuming he is able to do this because of lower costs, then this lower price is to be permanent. The division that has been doing a good job of continually improving its productivity can meet this lower price requirement and on occasion lead the pack instead of following it.

There has been some question as to whether automation, computers, etc. will produce increases in productivity that will be too high and as a result there will be fewer jobs. We can not conceive that productivity will ever go too high in any of our plants. Our concern is that we generate enough real improvement in productivity to better our competitive position or maintain a stable portion of the market.

We do find that increase in productivity is not uniform. Although we plan continually, there are times when industry has to wait for a break-through in product design or some external exciting cause to make up for a slack period in producing new approaches to our problem.

From a talk entitled "Can You Plan on Continuous Improvement in Productivity?" presented at the ASME National Production Engineering Conference, Detroit, May 1959.

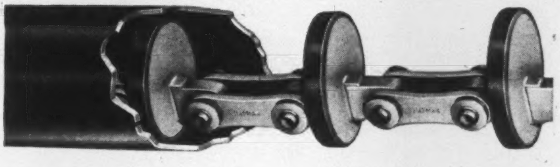
Circle 712 on Page 19

Hapman Conveyors

offer you these outstanding features for your flowable material:

- Completely flexible
- Compact
- Self-cleaning
- Self-supporting
- Self-feeding
- Dust, odor-tight

almost always



cost more

. . . *but return their cost many times.* Sound engineering, superior materials and workmanship go into every Hapman installation. With Hapman tubular conveyors you have minimum wear, minimum degradation, and maximum trouble-free performance. This is why you may pay more initially, but with Hapman you can be sure of the best conveying system . . . and save in the long run.

For Fact-Finding Report on Hapman Conveyors, write today to:

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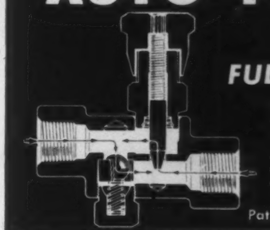
AUTO-PONENT®



HYDRAULIC FULL FLOW VALVES

Flow Control, Needle, Check, for HYDRAULIC Power

Model KF Flow Control Valve with Dial and Knob adjustment for direct reading and duplicating reference. Now available in Aluminum for 3000 psi.

Pat. #2,841, 174

A complete line: 1/8", 1/4", 3/8", 1/2", and 3/4" female Dryseal Pipe Sizes in all models and types. Equivalent Aeronautical Tube Sizes on special order.

MINIMUM PRESSURE DROP AND POWER LOSS . . . Oversize ports and passages give maximum flow at minimum pressure drop, insure greater accuracy and response in hydraulic or large volume air cylinder control.

EASY FLOW ADJUSTMENTS under full pressure. Seal located at port to eliminate air or dirt traps. Gland structure equally effective on pressure or vacuum.

SENSITIVE, CHATTERLESS BALL CHECK . . . Patented design insures rapid ball movement to open or close at low differentials.

FORGED BODIES permit higher pressures with wide safety margins. Aluminum—3000 psi; Steel and Stainless Steel—5,000 psi. Pressure ratings based on better than 5 to 1 safety factor. All internal parts are Stainless. Write for illustrated catalog.

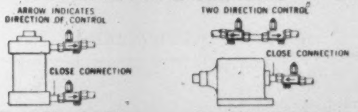
Model F Standard Flow Control Valve or Model H Needle Valve

Model KF Knob and Dial Flow Control Valve or Model KN Needle Valve.

Model PF Knob and Dial Flow Control Valve or Model PN Needle Valve for panel mounting.

Model C Check Valve for In-Line Mounting.

TYPICAL APPLICATIONS



Controlling Double Acting Cylinder

Controlling Single Acting Cylinder

AUTOMATION
AUTO-PONENTS INC®
COMPONENTS

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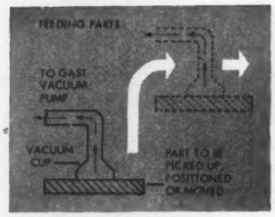
Circle 715 on Page 19



GAST
APPLICATION IDEAS

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Gast Booklet ready to give you

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on uses of air motors, compressors, vacuum pumps

Looking for new ways to improve methods—save time—or cut costs? This booklet may be valuable to you! With line drawings, it shows dozens of the basic principles of "putting air to work".

With photographs of our customers' products—from air mixers to data plotters—it illustrates each principle. . .and shows how Gast rotary Air Motors, Compressors and Vacuum Pumps provide advantages as original equipment or in plant use.

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GAST ROTARY

- AIR MOTORS TO 7 H.P.
- COMPRESSORS TO 30 P.S.I.
- VACUUM PUMPS TO 28 IN.

"Air may be your answer!"

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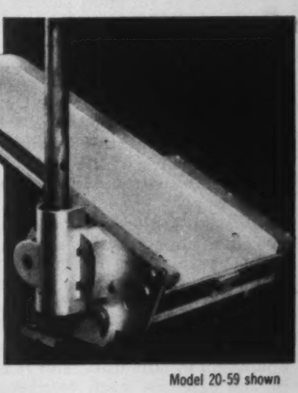
NEW

PART UNLOADERS REDUCE HANDLING



For fast, positive and lower-cost blank removal, use Lahr reciprocating chute unloaders actuated by your press stroke. Can be cable-timed (air power on out stroke) or rack-driven through full cycle. Simple mounting plus versatility of unloading to bins and conveyors. Variable stroke with gear change. Write for Brochure and Prices.

Model 20-59 shown

STANDARD MODELS AVAILABLE

Model No.	Tray Width	Tray Stroke	Power In	Power Out
20-RR-59	10" to 36"	10" to 20"	Rack	Rack
20-CT-59	10" to 36"	10" to 30"	Cable	AirCycle
30-RR-59	10" to 72"	12" to 30"	Rack	Rack
30-CT-59	10" to 72"	12" to 30"	Cable	AirCycle

Special tray widths and strokes available

Lahr MACHINE & TOOL CORP.
3400 MAPLEWOOD AVE. — TOLEDO 10, OHIO

Circle 716 on Page 19

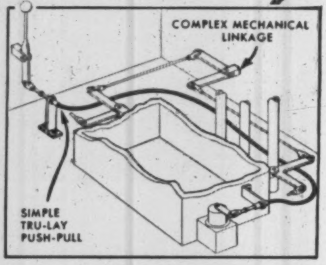
Improved Operation of literally hundreds of mechanical products has been effected with Acco Tru-Lay *flexible* PUSH-PULL Controls

Tru-Lay Push-Pull Controls provide POSITIVE REMOTE-ACTION over long or short distances . . . with fixed or movable anchorages . . . for light loads or loads up to 1,000 lbs., and these units are frequently and successfully used in conjunction with Electric, Hydraulic and Air Controls.

Flexibility makes it possible to snake around obstructions . . . simplifies installation . . . reduces the number of working parts . . .

Simplicity vs Complexity

Compare the TRU-LAY PUSH-PULL cable in illustration with the mechanical linkage. PUSH-PULLS are simple, have but one moving part, are noiseless and give lifetime service accuracy. Linkages are complex, made of many parts; they wear at many points. Their use brings increased backlash, lost accuracy and vibration rattles.



Positive Remote-Action and Flexibility, together with Precision and Long Life, explain why TRU-LAY PUSH-PULLS serve designers and users equally well in improving machine operations, whether the application is on such severe service jobs as Bulldozers, Power Shovels and Steel Mill Machinery, or on such light duty work as Photographic Equipment, X-Ray or Business Machines.

Immunity to Vibration makes these TRU-LAY PUSH-PULLS ideal as Remote Controls on shakers and other vibratory products.

Complete Protection Against Dirt and Moisture is a big factor in the use of this unit on machinery in Coal Mines, Cement and Steel Mills, Oil Fields and in many other industries.

Corrosion-Resistance of the unit, plated or with Stainless Steel construction as required by the use, has led to many applications in the Marine Field . . . salt water or fresh. Supplied with a rubber cover the unit operates effectively even when conduit is COMPLETELY IMMERSED.

Lubrication of the inner working member is for life.

Temperatures as low as —70°F will not hinder the proper operation of this unit, and it is thoroughly effective even in the extreme high temperatures encountered on Jet Engine, Furnace Door and Glass Furnace Damper control applications.

Our DATA FILE will answer your further questions. Write for a copy without obligation

Push-Pull
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are you stuck?

confidential file

Readers with problems concerning systems, equipment, or components for automated operations are invited to outline them to: The Editor, AUTOMATION, Penton Bldg., Cleveland 13, Ohio. Readers having solution suggestions are invited to submit them and should refer to case number and title of the problem involved. Dates shown with suggestions indicate issue in which the problem was presented.

CASE 2008-P

FEEDING PLASTIC-TIPPED PAGES

. . . We are interested in obtaining a paper sheet feeder that can handle the attached sample at rates of 5 to 8 thousand sheets per hour. (The sample is approximately 0.005 inch thick and 8½ by 11 inches in size; a short plastic strip, or tab, is folded about one of the long edges of the sheet.) The buildup on the tab side of a sheet is about 2½ times greater than on the opposite side. With 0.005 inch stock, this ratio is 3 to 1, resulting in a situation in which, for example, a 10 inch lift of plain stock will pile up to a thickness of 30 inches on the tab side. The additional thickness prevents the use of an ordinary hopper-type feeder. We do not wish to use two operators, one to continuously load the feeder, the other to handle the finished product . . .

Engineer

SUGGESTIONS FOR 1990-P (DEC. 1959)

TILE HANDLING

. . . We are manufacturers of the Termaco Tile Feeder, Autostacker, and Packing Conveyor used with the Chromosorter for automatic feeding, shading, sorting, and stacking this type of tile. Our experience so far leads us to further consideration of other materials handling problems in the ceramic wall tile industry, and we would like to discuss exact requirements and conditions with the company with the problem . . .

Richard Ferguson
Terrell Machine Co.

. . . It would seem that the primary problem in handling the ceramic tile would be to prevent breakage. A machine should be designed to provide a feather touch scheme to manipulate the tile pieces at the rather fast rate of 200 per minute. Whether or not this can be done economically, would seem to depend on the actual configuration of the kiln furniture which is used. We would be interested in investigating this problem further with an eye to a cooperative arrangement for reaching a solution . . .

V. H. Simson
Cutler-Hammer Inc.

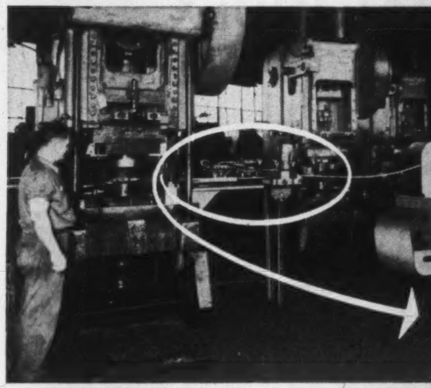
. . . Would you please forward on to your inquirer the enclosed literature on the Trayloader. We believe our machine will automatically load the tiles described . . .

W. C. Williams
Manufacturers-Engineers Co.

. . . Since we have specialized in materials handling, more especially the loading of pallets at high speeds, we offer our services. We would appreciate information concerning the company involved so that we may pursue it further . . .

Frank M. Maly
Cee Kay Industries Inc.

Circle 717 on Page 19



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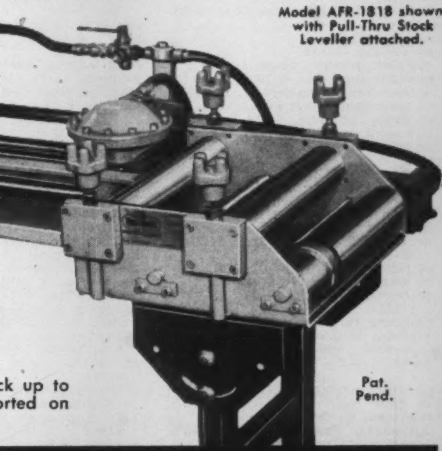

Model AFR-1818 shown with Pull-Thru Stock Leveller attached.

Pat. Pend.

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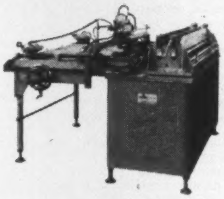

Ses-Matic Double Air Feed for materials up to 72 inches wide. This unit feeds stock 72" wide by .074 thick and removes coil bend with a Pull-Thru Leveller.

Ses-Matic Air Feed for wide stock up to 30 inches wide. Stock is supported on roller wheels.

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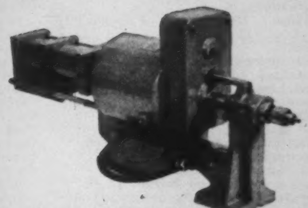

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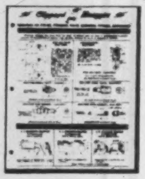

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By John N. Warfield, associate professor of electrical engineering, University of Kansas; 175 pages, 6 by 9¼ inches, published by Prentice-Hall Inc., New York; available from AUTOMATION; *$6.00 postpaid.*

In recognition of the rapid developments in the analog computing machine field, the author has specifically attempted to avoid material that is likely to become obsolete soon. The book is primarily concerned with electronic differential analyzers. With an increasingly widespread use of such equipment in industrial, scientific, and academic areas, the book should prove of value to engineers, educators, and students in all branches of engineering science. The subjects covered include: Differential equations, scaling, signal flow graphs, simulation, function generation, checking results, and difference equations and applications to integration.

CONTINUOUS ANALYSIS OF CHEMICAL PROCESS SYSTEMS

By Sidney Siggia, manager, analytical research and service department, Olin Mathieson Chemical Corp., 381 pages, 6 by 9¼ inches, published by John Wiley & Sons Inc., New York; available from AUTOMATION; *$8.50 postpaid.*

Analytical devices designed to attain economical, accurate, and continuous monitoring of process systems are described in some detail. The range of application of continuous, on-stream analysis has broadened considerably in the last few years, and with continual progress in related fields, such as computer controls, an even steeper rate of growth can be expected. The author has rounded up information from a variety of sources and describes each instrument according to principle of operation, range of application, accuracy and precision, installation and construction specifications, use with controllers, etc. Examples of applications in actual systems are also described.

MANAGEMENT FOR THE SMALLER COMPANY

Edited by Elizabeth Marting; 399 pages, 6 by 9½ inches, available from the American Management Association Inc., 1515 Broadway, New York 36, N. Y.; $6.00 to AMA members, $9.00 to nonmembers.

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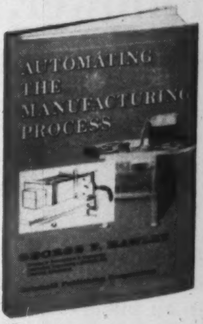

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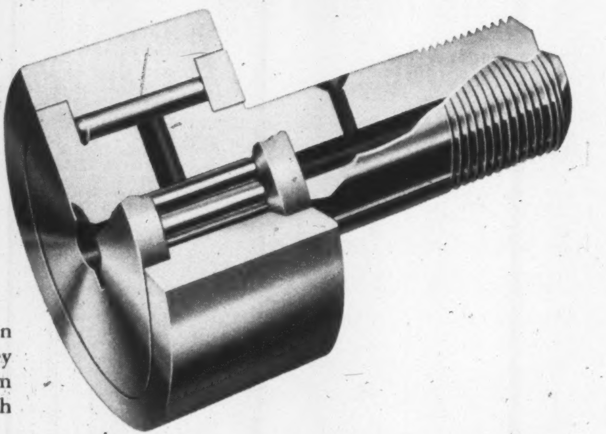

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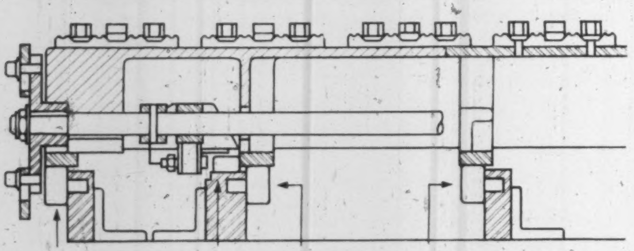

CAMROL® bearings accurately support and guide fixtures in automatic NATIONAL ELECTRIC WELDING MACHINES

Work-holding tables arranged as a continuous conveyor carry condenser assemblies beneath welding rollers in multiple station resistance-welding machines manufactured by National Electric Welding Company for a manufacturer of household refrigerators.

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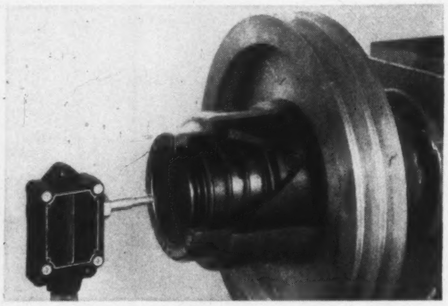
CAMROL® bearings add precision protection to overload cut-outs on ANCHOR CONVEYORS



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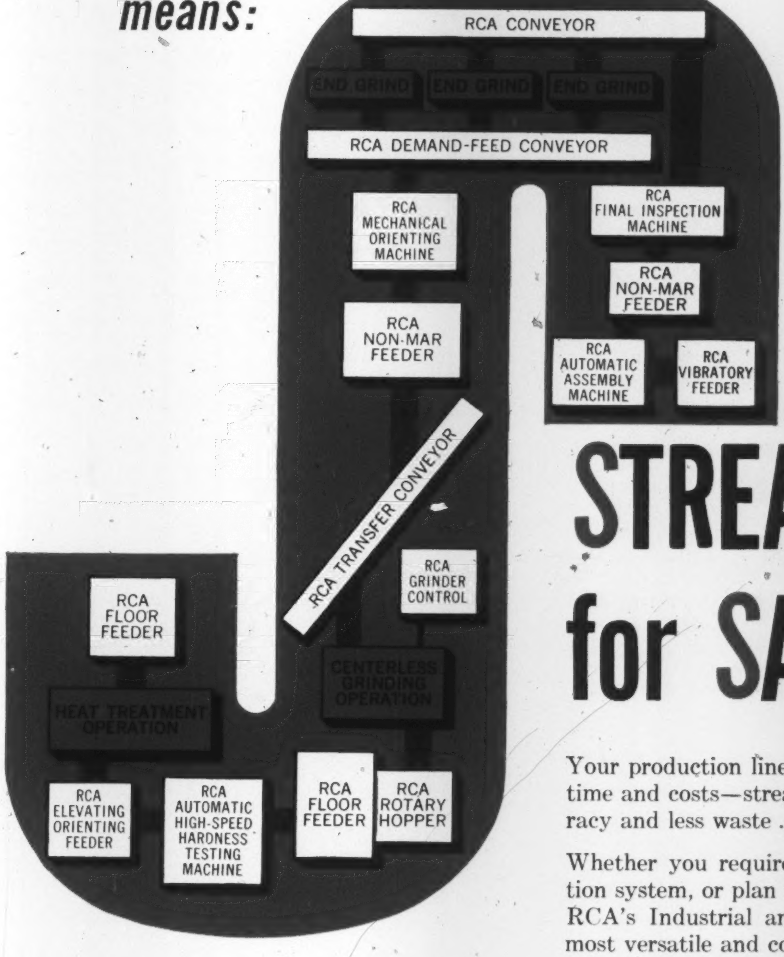
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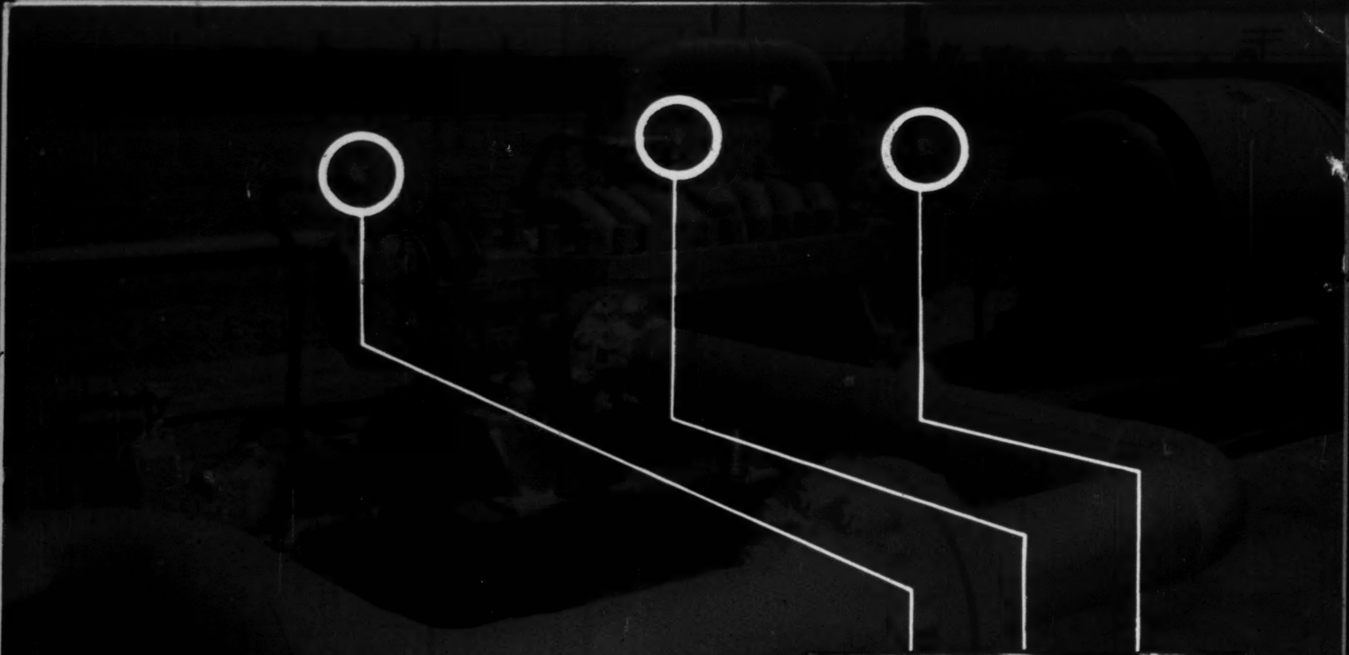
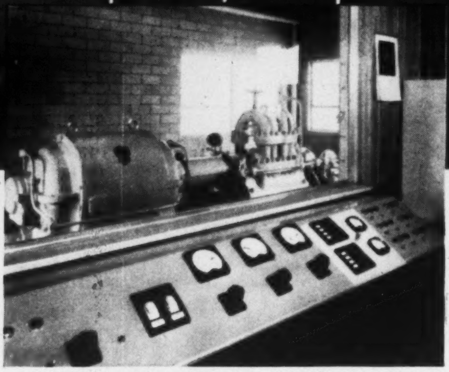


Edison detectors, installed at critical temperature points on this pump, guard against overheating.



Omniguard and indicating units are installed in control console. Warning system identifies a hot bearing by an alarm light and automatically shuts down the equipment. Indicators enable operator to read exact temperature of all bearings from console.

THOMAS A.

EDISON

omniguard systems protect unattended pipeline booster stations

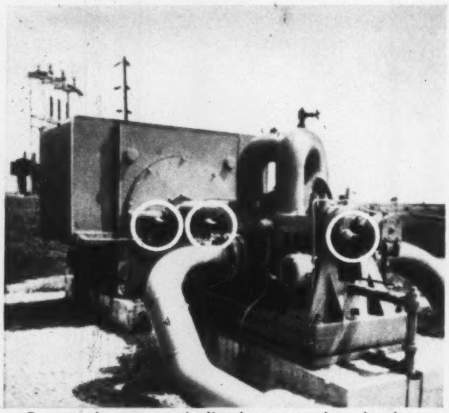
To pump more oil at less cost, pipe line operators use satellite booster stations. These stations are unattended. In order to protect critical equipment operators rely on Edison Omniguard temperature monitoring systems.

Omniguard detectors are installed at critical temperature points such as inboard and outboard sleeve bearings on the motor, inboard and outboard ball bearings on pump. In addition, they monitor pump casing temperature, and temperature of oil on discharge side of pump.

Indicating panel is usually located in supervisory station miles away. In event of overheating, pumping motors are immediately shut down and information is automatically relayed to supervisory station. Trouble-shooting personnel are quickly dispatched to put station back in operation, or standby equipment can be automatically cut-in by Omniguard.

This reliable, economical system is playing a major role in insuring the continuous, profitable operation of more and more pipe line stations.

If you would like further information about the Edison Omniguard system, write for publication 3036C.



Pump and motor at pipeline booster station, showing Edison detectors (circled) on inboard and outboard pump bearings and pump casing.

Thomas A. Edison Industries
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McGRAW EDISON

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